SUMMER TRAVEL

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. X. No. 113 MAY, 1929. PRICE 1s. NET

NEW CHALLENGE TO WORLD SPEED RECORD.
(See page 155)

CHIEF CONTENTS.

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Editorial Notes.

THE stimulus which aviation received during the war has had no more interesting outcome than the development of air archaeology. This new science owes its beginning to British initiative, among those who have taken the most active lead being Mr. O. G. S. Crawford. Writing this month on the "Archaeology of To-morrow," he points out that future progress is largely synonymous with this new research. Extensive surveys by aeroplane have already been made over the sites of many ancient settlements and camps in Britain, and now Mr. Crawford proposes to carry out similar investigations in the Middle East. Photographs taken by the Royal Air Force during ordinary duties of patrol in Mesopotamia contain sufficient evidence to indicate to the expert eye the existence of ruined cities, of which no trace can be seen by an observer on the ground. The fact that objects at great depths in the sea are visible from aeroplanes has long been known and was of practical use in the warfare against submarines; on the other hand the possibilities of similar application in archaeology was a later discovery. The general plan and outlay of ancient earthworks and other buried structures can often be observed from the air, when otherwise weeks of excavation would be required to obtain the same information. Much time is also saved by the archaeologist who can dig systematically instead of having to work out a plan as each new feature is revealed by the spade. Certain sciences undoubtedly suffer from being too much "up in the air," and it is an amusing reflection that the science most closely associated with the ground should in this matter be the brilliant exception which proves the rule.

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Two years ago much interest was roused by the first article which Herr Max Valier contributed to *Discovery* on rocket flying. Unlike the nebulous proposals of which the scant literature of the subject had previously consisted, this German aviator advanced details admittedly speculative, but worked out with some regard to scientific principles. Meanwhile he has made practical trials of the rocket as a propellant, first with a racing car and later with a sled, and now in this issue he outlines plans to fly the Channel. A few paragraphs appeared in the London newspapers in February, when Herr Valier achieved remarkable speed on the ice at Lake Starnberg, but only from his article does it now become clear what tremendous possibilities the experiments indicate. After preliminary trials the rocket sled was improved, until it is claimed on the final run a speed of nearly 249 miles per hour was achieved over a short distance. At that time Major Segrave had not yet made the new world record for motor racing, but Herr Valier's result would appear to have bettered this speed by about twenty miles per hour. As he admits on another page, it can hardly be hoped that the channel will be "rocketed" at the first attempt, but certainly the success of his land experiments shows that Herr Valier is working on the rocket idea with serious determination.

*   *   *   *   *

We commented here recently on a paper read to the Linnean Society about the relation of colour to environment in Arctic animals. Another problem of interest to students of Evolution has now been presented by Dr. G. S. Carter and Mr. L. C. Beadle, who discussed the respiratory adaptions among fishes in the swamps of the Paraguayan Chaco. That certain fishes became amphibian has been attributed to various factors, but aerial respiration is a necessary preliminary to migration on to the land. The new

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suggestion is made that in waters of the type studied in Paraguaya—which are very deficient in oxygen—aerial respiration was evolved as an adaption to lack of oxygen while the fish was purely aquatic. The two sources from which fishes in these swamps may obtain the oxygen necessary to life are the well-oxygenated surface-film of the water, and the air above the water. Of the twenty species collected by Dr. Carter, eight were discovered to breathe air and the remainder made use of the surface-film, many of them living in very foul pools by this means. This respiratory development opened the way to the later changes definitely associated with the migration.

* * * * *

After an absence of nearly a year during which no news was forthcoming of their movements, two Canadian explorers have now reported by wireless that their expedition in the Thelon game territory has been successful. The study of the 15,000-square-mile game preserve, which is east of the Great Slave Lake, was begun in April last year, and from that time until the receipt of the wireless message no word had been received from the missing men. Police patrols and other parties passing through the areas were asked to keep watch for them, but without results. Much valuable information was obtained by Messrs. Hoare and Knox during their travels. Musk-ox were seen along the Hanbury river and tracks of these rapidly disappearing big game animals were noted in the vicinity of the Thelon river. Large herds of caribou were reported south of the preserve. Wolves were also numerous but they proved wary of both trap and gun. After working already for over twelve months, the explorers now expect to conclude their expedition in the autumn.

* * * * *

An important development in industrial chemistry was announced by Dr. G. C. Clayton last month at the annual dinner of the Oil and Colour Chemists' Association. This concerns the supply of tung oil from sources within the Empire. The oil is essential for the production of certain varnishes, and in the past has been produced from nuts grown in China. Difficulties having arisen in obtaining supplies of the oil, British chemists attempted to obtain the nuts from China in order that they might be grown within the Empire, but were unable to obtain them direct. Through the courtesy of the American Tung Oil Corporation, however, 700 lbs. of tung oil nuts were obtained last year, and distributed to 32 stations throughout the Empire—in Australia, New Zealand, South Africa, India and other places. There is now no doubt that, as the result of this development, this raw material will shortly be produced within the Empire. The work has been done in conjunction with the authorities at Kew, and the Empire Marketing Board is also helping. It was clear from the tone of Dr. Clayton's remarks that there is every hope that the problem will be successfully solved. In view of the growing importance of the oil in various industries, the prospect of obtaining it from Imperial sources will be viewed with satisfaction.

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The supply of radium was the subject of an announcement in the House of Commons on April 16th, when the Chancellor of the Exchequer stated that the sub-Committee of the Committee of Civil Research had expressed the opinion in a new report that twenty grammes of radium, in addition to the stocks already available, should be acquired before the end of 1930. To raise the necessary sum of £200,000 it was recommended that a public appeal should be issued, and that the Government should contribute pound for pound to the fund. Mr. Churchill announced that the Government had accepted the recommendation, and would contribute on this basis up to a limit of £100,000. Fresh discoveries regarding the use of radium should be stimulated by this assistance.

* * * * *

The work which Australian agriculturists are now doing on problems of irrigation and the soil is important to farms the world over, as Sir John Russell showed in our April issue. We have therefore read with added interest some notes on soil surveys in Canada, published by the Dominion Government, from the pen of Mr. W. A. Johnstone, an official geological surveyor. As its name suggests, a soil survey of any area shows the character and location of the several types of soil. The fundamental principle of a survey is that each type is best adapted to certain kinds of crops and requires the same farm practices and methods of improvement. The perennial question of how long exclusive grain growing can be carried on in the prairie provinces turns partly on the character of the soil, for some soils can be cropped continuously much longer than others. Again, the occurrence of soil drifting has become a serious problem in many districts, and surveying affords a guide to its solution. The Canadian Geological Survey has investigated the soils in several important farming areas. Parts of Ontario and Manitoba were specially mapped for the purpose of supplying information to intending settlers. It is held by some critics that agriculture, the oldest and most fundamental of the sciences, is the least developed, hence this new work in the British Dominions is an excellent omen for the future.

The "Next Step."—V.

The Archaeology of To-morrow

By O. G. S. Crawford.

"Archaeology is still, as a science, in its youth; it is still far from maturity and has many problems to solve. Until we can compose a chronological table, in years, giving in rough outline the stages of development through which man has passed from the late palaeolithic period down to the dawn of history, we cannot be said to have accomplished the first and most urgent task before us."

ARCHAEOLOGY is the study of the past so far as it relates to man. There have been people in all ages with claims to be called archaeologists, but they have been most numerous in periods of declining civilization. The outworn culture, too tired to act, looks back in reverie to the doughty deeds done in the heyday of its youth. Old age recalls its childhood more readily than its maturity. Only when the life of action offers less scope or has less attraction, does science win recruits from the ranks of youth; and even so they tend to become scientific administrators rather than students. Archaeology is a symptom of old age, and is characteristic of decadent periods, such as the present, when public life is commercialized and when art therefore has nothing to say. It is therefore an unhealthy sign when the study of the past absorbs as much attention as it does to-day. It implies a cynical disregard of the present; it reverses the proper sequence from thought to action, and yet has not, like literature, the merit of being "experience recollected in tranquillity," for one cannot "recollect" the experiences of dead men, though one may evoke them and their goods from the grave. One may agree with Professor Sir Flinders Petrie in thinking that "the man who knows and dwells in history adds a new dimension to his existence; he no longer lives in the one plane of present ways and thoughts; he lives in the whole space of life, past, present, and dimly future"; but one feels, nevertheless, that Pericles was, on the whole, a better, happier man than Pausanias.

The Reminiscent Phase.

Admitting all this, one may yet prophesy a great future for the study of the past. For, just as in the individual there are certain activities appropriate to each stage of life, so, too, each phase of civilization has its own proper activity. To boyhood belongs the epic and love-sonnet, to maturity the drama, and to old age the novel and the critical essay. Each is supreme in its own sphere, but there is one glory of the sun and another of the moon, and the two are not comparable. Archaeology is one of the activities appropriate to that phase of civilization in which we are now—in this context it might be called the Reminiscent Phase. It is therefore an entirely legitimate pursuit for the creative artist who might, if born in other periods, have found other and better outlets. For, though not an art, archaeology does give scope for some of the artistic faculties—such, for instance, as creative imagination, critical insight and perseverance; and, since the life of the excavator is a life of action, not of contemplation, it attracts those who might otherwise have made their names as great administrators or generals. Archaeology, therefore, is one of those things which our generation is doing extremely well—physical science is, of course, another; and it is not unlikely that our achievements in these fields may be remembered even when those responsible for the Great War are forgotten.

Many Problems.

Archaeology is still, as a science, in its youth; it is still far from maturity and has many problems to solve. It is at a stage of development comparable to that reached by Gothic architecture in England in the eleventh century; it has not yet achieved complete mastery over its material. When it has done so, it will decline and cease to attract adventurous spirits. From being "in the air," it will become shrouded in textbooks and be taught as a "subject" at schools and universities. In a word, it will be dead. Meanwhile it is now very much alive and on the up-grade, and the main problem, that of chronology, has yet to be solved. Until we can compose a chronological table, in years, giving in rough outline the stages of development through which man has passed from the late palaeolithic period down to the dawn of history, we cannot be said to have accomplished the first and most urgent task before us. The completion of such a table is proceeding apace, especially in Mesopotamia, and it may be completed within the lifetime of some now living.

Having achieved order in the time-aspect of our science, we shall also achieve it in the space-aspect. What a chronological table is for the one, a map is

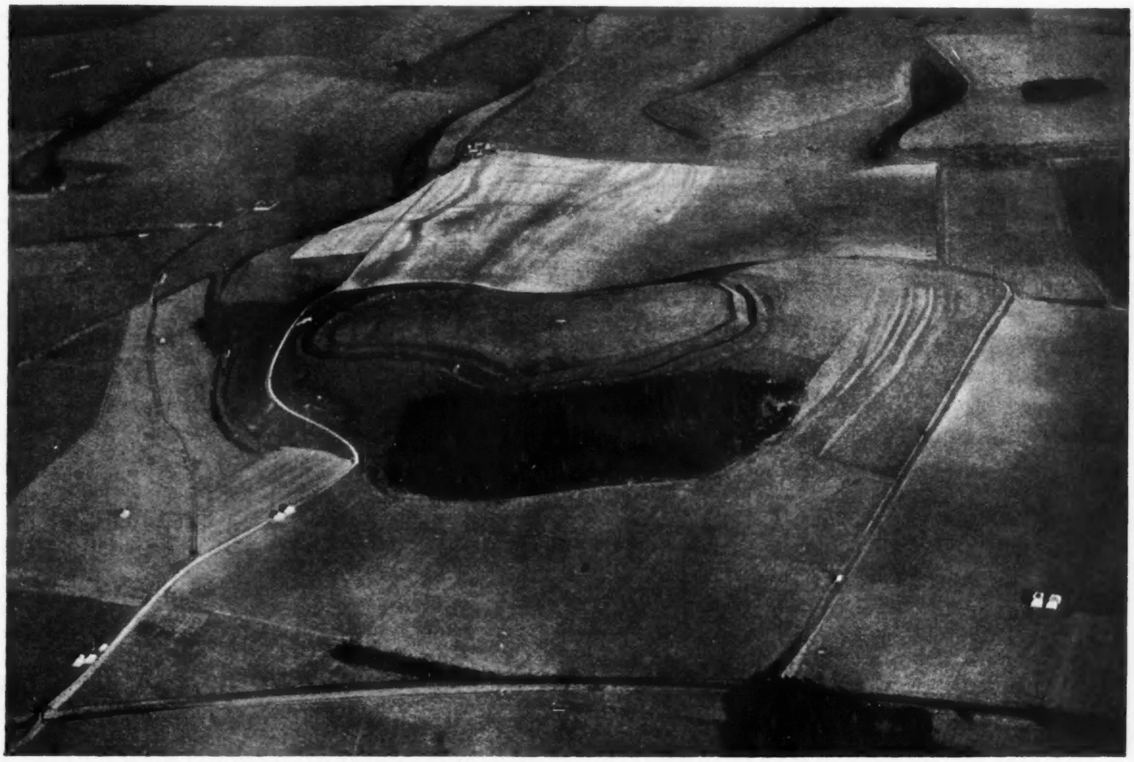
for the other. We shall have maps showing the state of the world at each successive phase in the development of culture. Such maps are gradually coming into existence. They will soon be indispensable, for the torrential and rising flood of archaeological literature will make reading impossible, and a single map conveniently synthetizes a mass of related facts. The student of the future will not spend much time reading, though, of course, he *will* read and browse in libraries. He will pore over distribution-maps which will display the main features of the period against a background of the existing environment. The maps of the immediate future will probably grow out of the International Map of the World on a scale of 1 : 1,000,000.

In the compilation of such maps, air-photography will play a part. It would, for example, be possible to publish immediately a map of Trans-Jordan in Roman times if an air-survey of that country were to be undertaken. The Roman roads, forts and towns could be spotted at sight on the photographs, and the documentary sources would supply the names. In Europe air-photography will reveal many new sites and explain many old ones, when it is applied to the task, though so far nothing has been tried in this direction outside England. The soil of France is admirably adapted to this branch of research, and it is one which is more to be recommended to our neighbours than excavation, for many reasons. In countries like our own, which have perfected the technique of excavation, air-photography will be—in fact already is—an indispensable aid. An air-photograph will always be taken before work is begun; conversely, sites whose plan is revealed by crop-marks will be chosen in preference to others where the digging is by comparison blind.

Excavation, it must be remembered, is only one—even if it be the most important—of the archaeologist's tools. Yet it has come to be the normal reaction of all archaeological bodies to all external stimuli; they go to ground as instinctively as rabbits and often with as little preliminary thought. Excavation is popular;

WHAT THE AEROPLANE REVEALS.

Prehistoric fields underlying an ancient camp at Bathampton Down, Somerset, as revealed by air-photography. The identification of a lost agricultural system by this method illustrates its immense possibilities for the archaeologist. (Reproduced by permission from "Wessex from the Air," by Crawford and Keiller, Clarendon Press, Oxford, 1928.)



AN ANCIENT CAMP FROM THE AIR.

Another air-photograph, taken in Wiltshire at Battlesbury, near Warminster, giving an oblique view of the fine prehistoric camp. The earthen ramparts are clearly seen, with Salisbury plain beyond. (Reproduced by permission of the Air Council. Crown copyright.)

it fills museums (though most of ours want emptying rather!); it appeals to the collector; and it may well provide sensational copy for the press. It is therefore less difficult to raise money for an excavation than, for instance, for an air-survey or for a large-scale map of the Roman Empire. Nevertheless, both of these latter are more worth while than many of the excavations now in progress—instances of mere "digging for digging's sake"; and either could be achieved for the cost of about five seasons' work. Should these words meet the eye of someone susceptible to ideas, with imagination, and with money to spend—he might do worse than spend it on an air-survey. The purely scientific results would be immense; but, if some unmapped eastern land were to be chosen, there would be practical results as well. What a chance there is here for someone! The organization exists, and can be put in motion at once. Such a survey would make history; it would vitally affect the whole future course of archaeology; it would speed up its progress and set the pace throughout the world. It would do what the Challenger expedition did for biological science, or the *Daily Mail* prizes for flying itself.

Such developments as these will in time react upon educated opinion, and so ultimately upon education itself, including museums, which will be instruments of education. If this reaction takes place, as it well may, while archaeology is still a live subject and "in the air," the result will certainly be good. As a subject it is concrete and certainly has educational value; its principles are easy to understand, and its results can be presented attractively. Like geology, it can be applied to almost any region in which the pupils may happen to reside.

These events may be enacted in the manner suggested above, or they may be forestalled by another great war. There is in any case no reason to suppose that archaeology, as a live subject, will last more than a few centuries, nor is it desirable that it should. As a pastime to while away the weary hours of decadence between one great period and another, it serves a useful purpose, but it is not an end in itself, like art or life.

New Light on the Coal Measure Forests.

By A. C. Seward, Sc.D., F.R.S.

Professor of Botany in the University of Cambridge.

A recent collection of many thousands of fossil plants made in South Wales by Mr. D. Davies has thrown fresh light on the composition and conditions of growth of the successive forests which flourished over a wide area in the northern hemisphere during an age separated from the present by perhaps two hundred million years.

ONE of the aims of *Discovery* is to foster the spirit of research; an obvious method of effecting this is by descriptions of scientific investigations made in different fields which are likely to stimulate readers to contribute by their own independent efforts to the advancement of knowledge. Successful research is not necessarily the monopoly of professional men of science, whose time is mainly occupied in teaching subjects which they are also advancing by their original work. Many contributions have been made by men and women who have had the good fortune to cultivate a hobby either cognate to their regular routine duties or in some other branch of knowledge.

The recent publication in the *Philosophical Transactions* of the Royal Society of London of a paper on the "Correlation and Palaeontology of the Coal Measures in East Glamorganshire," by Mr. David Davies, M.Sc., F.G.S., affords an excellent example of a piece of scientific work of exceptional interest and of great importance; it illustrates the possibilities of accomplishment by an enthusiastic student of Nature who is prepared to devote a considerable proportion of his leisure to the intensive study of the fossil contents of rocks in a given area. This paper was preceded by a communication on similar lines, by the same author, to the Geological Society of London, published in the *Quarterly Journal* in 1921, on "The Ecology of the Westphalian and the lower part of the Staffordian series of Clyded Vale and Gilfach Goch (East Glamorgan)." The two contributions give the results of researches, carried on during the last thirty years, which involved a thorough exploration of fossil-bearing rocks over an area in South Wales of about thirty square miles.

390,000 Specimens.

It is a comparatively easy task for a trained student of ancient floras to describe a number of fossil plants submitted to him by the collector of the material, but to collect nearly 390,000 specimens scattered through a series of beds having a total thickness of over a thousand yards, to name the stems, leaves, seeds, and other broken pieces, to make accurate counts of the examples of each species obtained from twenty-nine different horizons over a considerable extent of country, and to interpret the statistics based on the collections is a task beyond the reach of most of us. This type of intensive study is of great value, and though it can be successfully accomplished on the scale of Mr. Davies' work only by a few favourably situated and specially qualified enthusiasts, researches on similar lines and on a more modest scale might be undertaken by many who desire to give practical proof of their devotion to science. Research of this kind is not for students whose ambition is to obtain quick returns for their labours; it is rather for those who are content to devote the leisure of several years to a task which will ultimately give them the satisfaction of having supplied a body of facts of real value as trustworthy evidence.

A Succession of Forests.

The coal-bearing strata form the upper part of that section of the earth's crust which is known as the Carboniferous system; they are termed by geologists the Coal Measures and include seams of coal separated from one another by beds of shale and occasional layers of sandstone. Each seam of coal is believed to represent the compressed and altered material derived from a succession of forests; the interspersed beds of shale and sandstone are the hardened mud and sand deposited by rivers or during incursions of the sea over the sites of temporarily submerged land areas. The series of rocks examined by Mr. Davies, having a total thickness of 1,150 yards, include twenty-nine different coal seams, distributed through layers of shale containing portions of stems, branches, leaves, seeds, or other debris carried by water flowing through a forest-covered region and deposited along with mud and sand on the floor of a lagoon, or of an estuary which was being silted up by the gradual formation of a delta. The seams of coal mark twenty-nine distinct periods when the land, either dry land or flooded swamps, was covered with vegetation; the associated shales and other sedimentary beds are records of recurrent depressions of the forests below

water-level. One can make no accurate estimate of the time represented by the whole series of the Coal Measures ; it must have been of very considerable duration—measured by hundreds of thousands of years. In the classification of the Coal Measures adopted by British geologists on the authority of the late Dr. Kidston, the lowest beds are spoken of as Westphalian, the next above these as Staffordian, and the highest as Radstockian :—

COAL MEASURES.

Radstockian :	48,516 plants collected from three horizons.
Staffordian :	111,666 records of plants from eight horizons.
Westphalian :	229,801 plants recorded from eighteen coal seams.

Below each seam of coal is an old surface soil, the underclay, containing long spreading root-like organs clothed with slender rootlets, still intimately connected with the earth from which they once drew water and raw food materials for some of the forest giants that contributed to the pile of vegetable waste and ultimately to beds of coal (see Fig. 1). These subterranean rootlet - covered organs are assigned to the genus *Stigmaria* ; they served as the anchoring and absorbing roots of trees such as *Lepidodendron* and *Sigillaria*, which belong to the class Lycopodiales now represented by the inconspicuous Club Mosses (*Lycopodium*) and allied plants. Mr. Davies states that " not a single instance is known of any change in the character of the floor " on which every seam of coal rests ; the underclay contains no remains of drifted plants. These facts lend support to the view that the underclay is the actual floor on which the forests grew, and that the seams of coal in the district investigated were formed from peaty material derived from generations of trees and humbler plants which grew on the spot, and not from material carried by water from neighbouring forests. The evidence, in other words, favours the growth-in-place theory and not the drift-theory of the origin of coal.

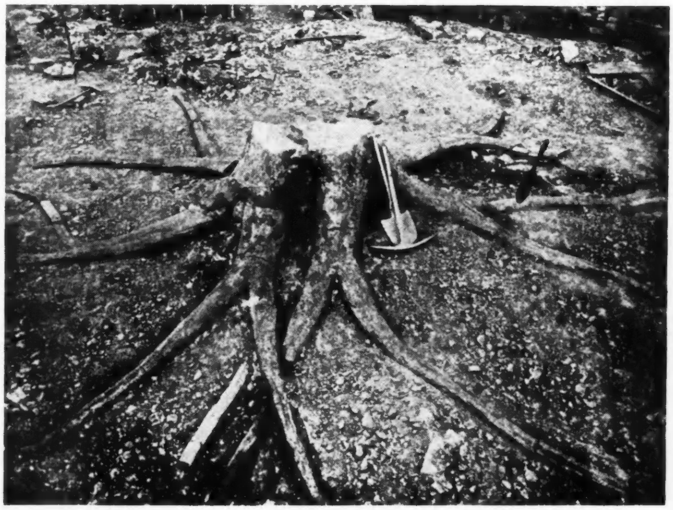


FIG. 1.
ANCHOR ROOTS OF COAL FOREST TREES.
Stigmaria in an old surface soil, showing the spreading and forked roots which bore numerous spirally disposed rootlets. (The latter are not shown in the photograph.)

An important part of the research was the counting of specimens of each species collected from the different horizons ; a table is given showing the height in feet above each seam where the fossils were obtained from the shale. The purpose of the counts was to ascertain the nature of the vegetation—the proportion of the various classes, genera, and species in the successive forests. Over 300 species were identified ; 56 belonging to the Equisetales, 8 to the Sphenophyllales, 95 to the Lycopodiales, 141 to the Filicales and Pteridosperms, and 23 to the Cordaitales. The Equisetales include stems of several species of *Calamites*, different forms of foliage-shoots which, because of their frequent occurrence as detached specimens separated from the parent stems, are not assigned to the genus *Calamites*, but are spoken of as species of *Asterophyllites* or *Annularia* and regarded as Calamitean branches. Similarly, several types of reproductive shoots, or cones, and certain detached roots, though known to belong to species of *Calamites*, are referred to under separate generic names. The only genus of the Equisetales in the world to-day is *Equisetum*, represented in the British flora by the common Horsetails.

The Calamites, which became extinct not long after the close of the Carboniferous period, were woody trees differing not only in their much greater size, but in many other respects from the remotely related Equiseta with which we are familiar. The class Sphenophyllales, so far as we know, became extinct before the end of the Palaeozoic era ; it was represented in the forests of the Coal Age by the genus *Sphenophyllum*, characterized by the long and slender stems bearing whorls of wedge-shaped leaves. *Lepidodendron*, *Sigillaria*, and other trees, with their foliage shoots, cones, and the root-like Stigmarias, were the chief representatives of the Lycopodiales. The Filicales, or true ferns, are grouped with members of an extinct

class, the Pteridosperms, because it is often impossible to distinguish between the fronds borne by plants of these two groups. The Pteridosperms, or fern-like seed-bearing plants, differed from ferns in the possession of seeds and pollen-bearing reproductive organs in place of the one kind of reproductive organ, the spore-capsule with spores. These remarkable plants played a prominent part in the vegetation of the world almost from the time when terrestrial floras had first colonized large areas of the earth's surface; how long the class persisted we cannot definitely say, but it reached its maximum during the Coal Age and then rapidly declined.

Another extinct class, which reached its zenith before the close of the Palaeozoic era, was represented in the forests of the Coal Age by *Cordaites* and other trees resembling in the structure of the wood existing Araucarian Conifers, and in the long strap-like and parallel-veined leaves agreeing generally with most species of the genus *Agathis* (*e.g.*, the Kauri Pine of New Zealand), closely related to *Araucaria*; in the reproductive shoots the Cordaitales differed widely from all living Conifers. The statistics based on innumerable counts are given as tables and charts in Mr. Davies' paper; part of one of these is reproduced in Fig. 2. The breadth of the irregular black columns shows the relative abundance of the various classes. Considering the whole of the Coal Measures examined in Glamorganshire, it is found that the class Equisetales dominated the vegetation on thirteen horizons, the Ferns and Pteridosperms (mostly the latter) on ten horizons, the Lycopodiales on four, and the Cordaitales on two horizons. The table (Fig. 2) shows that the Ferns and Pteridosperms were dominant during the Staffordian and Radstockian stages and that the Equisetales occupied a more prominent position in the Westphalian stage. Statistics demonstrate that on each horizon where a particular class was dominant there was also a certain genus more abundant than the others. Whenever the Lycopodiales were the most numerous the Ferns and Pteridosperms became reduced in number; as the Lycopods fell off the Ferns and Pteridosperms took their place. On the other hand the Equisetales and Cordaitales maintained a greater constancy from one horizon to another. It is often stated, and Mr. Davies agrees with the opinion, that the Lycopodiales grew in wet, marshy ground; the Equisetales in damp situations; the Cordaitales on drier ground, though able to exist in comparatively wet soil. The Sphenophyllales seem to have preferred the company of Ferns and Pteridosperms which, as a class, are believed to have flourished best in dry situations. The Equisetales and Cordaitales may be described as intermediate between the Lycopods and Pteridosperms in that they were able to adapt themselves to changing environments (see Fig. 3). It is, however, impossible to define precisely the conditions most favourable to the several classes, and it would be rash to assume that we can correlate within narrow limits the units in the Coal Age forests with the nature of the ground on which they lived.

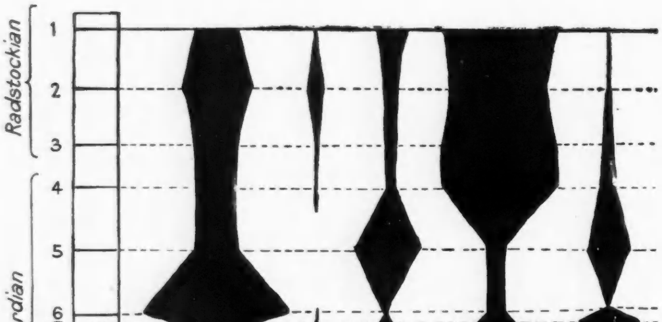


FIG. 2.
PLANTS IN THE COAL PERIOD.
Part of one of Mr. Davies' charts illustrating the varying fortunes of certain classes of plants in the course of the coal period. The coal seams are indicated in the left-hand column (1-29).

FIG. 3.
TYPES OF PLANTS AND TREES IN A COAL PERIOD FOREST.
Besides the various examples named above in the diagram, a specimen of *Sphenophyllum* (S) is included, drawn on a much larger scale.

Mr. Davies comes to the conclusion that the dry plant associations, especially the Ferns and Pteridosperms, were more frequently dominant than those which required wetter conditions. If this inference is correct it suggests that the popular association of the coal forests with wide stretches of marsh and swamp should be modified; there must have been long periods when the forest-covered country was well above the swamps. It is at least certain that there were frequently recurring changes in the composition of the vegetation, and these were undoubtedly connected with the fluctuating height of the land. At one time there were sheets of shallow water and dense vegetation growing in swampy ground, many of the trees standing in water; at other times much of the forest-clad land would be raised above the permanently wet marshes, which would continue to be fringed by assemblages of plants differing from those on the higher ground. There are many other aspects of this enquiry into the ecology of the coal forests, but enough has been said to give a general idea of the scope and aim of the type of research by which Mr. Davies has earned the gratitude of students of ancient floras.

An important point to bear in mind is the effect upon the vegetation of the inconstancy of the physical conditions, an inconstancy which is only apparent when we remember that oscillations of the earth's crust, clearly demonstrated by the records of the rocks, are events spread over a lapse of time measured in thousands and even in millions of years. The geologist's standard of time is very different from that of the layman whose vision tends to be confined within the narrow limits of human chronology. Geological evidence tells us that the surface of the earth's crust during the Coal Measures, as in the whole course of geological history, was by no means stable; for long periods, and over wide regions of the northern hemisphere, generations of forest trees succeeded one another under uniform conditions; but the separation of one coal seam from another by layers of shale is proof of submergence and the flooding of the forests by water laden with sediment and scraps of vegetation. By degrees the depressed area became silted up and were colonized afresh by invading trees and shrubs. These up-and-down movements varied in duration and in intensity; the changes in the inorganic world are reflected in the organic world; this is one of many conclusions of general interest which can be drawn from the statistics based on the fragmentary relics of an inconceivably ancient vegetation scattered through the rocks of South Wales.

Wireless and Weather.

DR. JOHNSON has immortalized a brief chapter "concerning snakes" whose full text is: "There are no snakes to be met with throughout the whole island." Thus it is with the alleged effects of wireless on weather. The Symons memorial lecture of the Royal Meteorological Society for 1929 points out that the average rainfall of England requires for its production the expenditure of energy at the rate of a third of a million horsepower per square mile night and day throughout the year. This is the rating of the largest electricity generating station in Great Britain. The total rate of emission of energy from all the broadcasting stations of Great Britain and Northern Ireland, in the limited periods during which they work, is under 55 horsepower, the corresponding figure for Europe being about 400 horsepower. Any effect of broadcasting on weather would therefore be due to "sub-homeopathic doses" of less than one in a thousand million. Applying the same kind of arithmetic to the suburban home, one finds that to produce a year's rain for the tennis court by means of an electric kettle would cost £800 or more, while the home's contribution to the power bill of the local broadcasting transmitter is an eighth of a penny a year.

Lake Nemi Reveals its First Secret.

By Daphne Shelmerdine.

The draining of the Italian Lake Nemi has now revealed the prow of one of the famous barges of the Emperor Caligula. The writer has just returned from another visit to the scene of the operations, which were begun last autumn, shortly after her first article appeared in "Discovery."

SINCE the operations for draining the Lake of Nemi, near Rome, were publicly inaugurated by Signor Mussolini last October, electric suction pumps have been working night and day, propelling the water through the old Roman emissary. Now there is visible the prow of the first of the sunken Barges of Caligula, which lies nearest the surface of the water and close to the shore. After six months of pumping the water in the lake has been lowered by six metres, and on the rotting wood of the prow, of which scarcely more than a foot appears as yet above the water, studded with huge bronze nails, a small Italian flag has been fastened.

Popular Interest.

The work has aroused enormous interest in Rome. Crowds flock out to the once tranquil little inns at Genzano, overlooking the lake, and the newspapers print constant news of the progress made, lauding the Fascist Government for succeeding where previous attempts, from the fifteenth century onwards, have failed. Above the pumping station is erected a flagstaff proudly bearing the Fascist sign, and soldiers guard, day and night, both the part of the shore where the barges lie and the pumps at the mouth of the emissary, which is further along the shore underneath the hill on which the village of Genzano stands. Entrance to the pumping station is allowed by special permit only. Nothing of artistic value has so far been salved from the barges comparable to the discoveries made in 1895, when the beautiful bronze head of Medusa, the fragments of mosaic pavement, and the bronze heads of lions and wolves holding mooring rings in their mouths, were placed in the Museo Nazionale at Rome. The divers have been hampered by the huge bronze nails sticking out from the ship, which damaged their apparatus. It has been thought wisest not to attempt any exploration of the barges until the water has been lowered.

From the shore, the form of the first boat, or rather of that part of it nearest the prow, is dimly discernible under the water. It lies at an angle, with its prow, now visible, tilted up on the steeply shelving shore and the stern further out towards the centre of the lake. A buoy has been fastened to the stern, so that a good idea of the length, which is about 200 feet, can be obtained. The barge is also tilted sideways, and the sweeping curve of the side nearest the shore gives an impression of its enormous width compared with its length. It is 65 feet wide, and therefore has the ungainly shape of a houseboat. It has been compared with the description of Caligula's pleasure boats given by Suetonius, in which he says that the Emperor would "sail along the shores of Campania, amid music and dancing," in ships "equipped with multi-coloured sails, their sterns set with gems, and provided with spacious baths and colonnades." It is difficult, however, to imagine these ungainly barges at Nemi moving at all within the confined space of the small lake, and the belief grows that they were used solely as houseboats and rarely moved from their anchorage.

Excavation Required.

From the shore it can now also plainly be seen how deeply the ship is embedded in mud, and even when the water is sufficiently lowered to uncover the whole length, it is evident that an enormous amount of excavation will have to be done, and that success is by no means assured. The first ship has been badly damaged by previous attempts at salvage; it was from this ship that the enormous timbers, now to be seen in the Museo Nazionale, were torn away. They were broken off by the chains fastened to them when an attempt was made to raise the barge through the water. It is hoped that the mud may have acted as a preservative for the unexplored interior of the barge, and the second ship may be in an even better condition, lying as it does more deeply sunken beneath the water and having suffered very little from previous excavation. The only discovery of value so far from this ship has been a fragment of a bronze relief, consisting of a hand and forearm, larger than life size, also now to be seen in the museum.

It is extremely doubtful, in any case, that the barges could be raised entire; they would have to be put together again piece by piece, and it is more interesting to speculate on the statues and ornaments

which may be discovered in them beneath the mud, than on such a reconstruction. Until excavation is possible, therefore, interest centres chiefly in the ancient emissary and the pumps at its mouth, by which the lake is being drained. This tunnel, constructed by Roman engineers, runs under the hill of Genzano to the plain of Ariccia, where it emerges as an open channel, is then continued for a short space by another tunnel, and finally another open channel conveys the water to the sea at Ardea.

Up to the present time only one entrance to the tunnel was known at Nemi. When the pumps were first installed at this entrance, only a trickle of water could be propelled through the channel. Signor Biagini, the engineer, had to clear the passage of fallen earth and boulders; no easy task, as it varies from 5 to 1.50 metres in height, and for the first 300 metres follows a twisted course. He then discovered, at a sudden bend, and at a point where the passage was extremely small and the obstruction greatest, that it was joined by another tunnel running into it at right angles at the bend. This proved to be a second arm of the tunnel, starting from a point considerably above the level of the lake, and about 150 metres in length. It was evidently used for removing the earth dug out when the channel was made, and has now been used again for the same purpose, rails having been laid down, so that a small truck could pass along it. A well-like shaft entered it from above, through which also the earth could be removed. This tunnel, unlike the other, is quite straight, and high enough almost all the way for a man to stand erect. It is now lit by electric light, and one can walk down it into the depths of the hill of Genzano, to the point where the water emerges from the confined space of the other tunnel, and can see it flowing away through the dark passage to the sea. The tunnel continues almost straight until, near its further end, it makes two sharp bends in order to avoid volcanic masses of rock which the Romans were unable to blast.

THE FIRST BARGE.

The prow of the first ship, now uncovered, to which is attached the Italian flag. The soldiers in the boat guard the shore day and night.

DRAINING IN PROGRESS.

The pumping station, constructed by the firm of Riva of Milan, showing two of the pipes. The shore is held up by stakes

The pumps themselves have already been moved once from the position in which they started working to one further down the shore. They will have to be moved again to a third position as the water is lowered. Four enormous pipes run beneath them down into the water. Later, some time after the pumps have been placed in their third position, these pipes will be extended by rubber pipes supported on pontoons. Only two pipes will be used at this stage, with two sets of machinery, placed one behind the other, in order to increase the pressure. It will be possible to lower the water by 23 metres from its original level.

As has been said, it has now been lowered by six metres, which uncovers the prow of the first ship; seven metres more will uncover the whole of this boat. As it has taken six months to lower the level of the lake by six metres, it will probably not be until the autumn that the whole barge will be visible, though the work may advance more quickly during the summer. It has been retarded hitherto by the heavy rainfall during the past winter, adding continually to the volume of the water. Snow, even in April, still lingered on the Alban Hills.

The Second Barge.

When the water has been lowered by 14 metres, or a metre lower than the depth at which the first boat will be completely uncovered, the uppermost end of the second boat will be visible. It lies at a slightly deeper slant than the first, and will not be entirely uncovered until a depth of 22 metres has been reached. Nothing is said at present about how far the work will be continued. Possibly the upper barge will be excavated before the lake is lowered to the depth of the second.

Through each pipe the water passes at the rate of 500 litres a second; 2,000 litres of water a second are pumped out of the lake when all four pumps are at work. During the last week in April, only one was working, the others being temporarily disabled by mud falling from the banks and choking the pipes, preventing water getting into the pumps. It had been thought that there was no possibility of landslides, as the steep sides of the lake are of hard volcanic formation, beneath which the water does not percolate. There has, however, been a slight landslip close to the pumping station, and also the layer of mud on the shores is continually slipping down as the water is lowered, and adding to the mud in which the barges are already embedded. Moreover, on the north-eastern shore of the lake, where the Temple of Diana stands beneath the village of Nemi, on the flat ground of Il Giardino, the soft earth is breaking away badly. Between the Temple and the lake, the land nearest the water has become a marsh. The little patches of flower gardens are threatened with destruction, separated one from another by water-filled chasms, as though a giant hand had been plunged into a jig-saw puzzle and moved the coloured pieces. The walls of the Sanctuary stand out clearly above, and it is evident that this flat marshy land, which has been planted with flowers and is now being reclaimed by the sinking water, was once covered by the lake, which extended to the Temple walls.

On the other side of the shore, close to the sunken barges, the lowered water has uncovered what appear to be the foundations of a little port or mooring place. Near the pumping station a double row of columns was found, and above stand the reticulated walls and archway of a Roman house, overgrown with trees. Fragments of pottery, mosaic pavement, part of the head of what was evidently a large statue, and amphora found in making the new road from Genzano, are collected in a shed behind the pumps (where may also be seen some excellent photographs showing the emissary as it was when first re-opened, and as it is now, cleared of obstruction).

It is known that Nemi was a favourite pleasure resort in imperial times, and beneath the whole of the hillside, from Genzano to the shore opposite the sunken barges, lie in all probability the remains of extensive villas, and perhaps statues, pottery and fine pavements await excavation. The new road from Genzano to the barges follows the line of the old Roman road, and in some parts the actual road has been discovered, and the paved way may be seen, in as excellent a state of preservation as the "triumphal way" which still climbs up to the summit of Monte Cavo, where the great Temple of Jupiter Latialis once stood. Fortunately this new road does not at all spoil the beauty of Nemi, as it was feared it might do; but it is said to be not very durably constructed. A beautiful road with a bad surface, however, is preferable to a wider "first-class motor road" which would mar the hillside of Genzano. Nemi, indeed, does not at present look very different at a first glance from what it did six months ago, until the steep shelving shore laid bare by the falling level of the lake becomes visible. But when the water is lowered by another 7 metres, and perhaps more, the lake will begin to look sadly diminished.

Refilling the Lake.

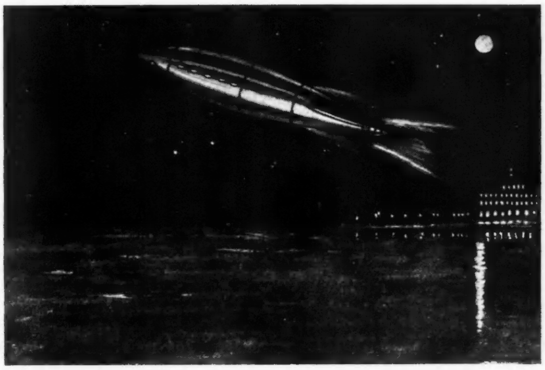
It was originally promised that the water should be pumped back again, when the boats had been removed, but this will not be possible; it would take two years to pump back the water which has already been taken during the last six months, and it will therefore be left to the rain and to the stream which flows from the once sacred fount to refill the lake. It will be many years before the Mirror of Diana regains its untroubled beauty. Now, in the place where the priest of Diana once watched before her sacred grove, Italian soldiers stand on guard. What will be found when the water sinks lower? Some treasures of the Emperor Caligula may be hoped for; but of the Sacred Grove and the cult of the priest-king, it seems unlikely that any further traces will be forthcoming.

By Rocket over the Channel ?

By Max Valier.

Having proved the power of rockets for driving a racing car and also an ice-sled, the German inventor hopes this summer to attempt a flight from Dover to Calais. If this first "rocket-ship" succeeds, practical experience will be afforded regarding the much-discussed proposals to fly in a larger rocket to the moon.

My reasons for believing that the rocket-ship is the aircraft of the future are already familiar to readers of *Discovery*.* It is theoretically adaptable for flights of any length and at hitherto unattainable heights, where the atmosphere is so thin that speeds of thousands of miles per hour should be possible. To utilize these higher strata of the earth's atmosphere for flying is the first object of the rocket-ship; projection into empty space comes second only in my intentions. It is, in fact, ridiculous of people to talk of my project to "shoot" myself to the moon; shooting does not enter into the question of transporting men through the air. Even with the flight of the future through space, it will be solely a question of increased starting speed, because the human body, while able to stand any speed at an even rate, does not support sudden increases or jerks beyond a certain point.



ENGLAND TO FRANCE IN FOUR MINUTES?

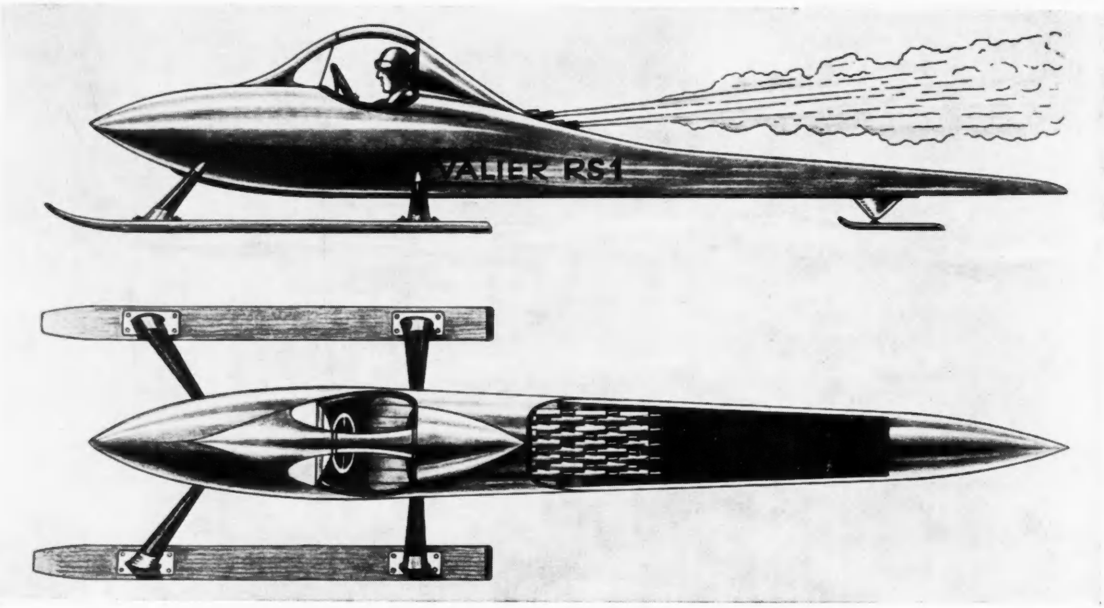
An imaginary view of a rocket-ship in flight over the Channel, showing the general character of the proposed machine.

Of course, we must start from the beginning. We are, to-day, in about the same position with regard to the rocket-ship that the world experienced before 1903 with the aeroplane. The first short low jumps of the Brothers Wright then broke down the barriers which had restrained the development of the motor-driven flying machine; so, to-day, with the first attempts of the rocket-ship, we must prove that this method of travelling is possible to mankind. Should the first "take-off" succeed, then everything will be open to us. The world will then believe in my idea and perhaps hasten to offer that help in further development which is at present withheld. For this reason I am determined to hasten the first actual attempts with a small machine equipped with rocket apparatus as means of propulsion. Unfortunately, though I have been writing and lecturing in the hope of raising what is required, as fast as I have got funds they have been employed in preparations to date. But I am going on, convinced that the rocket principle is sound; the objections which have been raised as to endurance, friction, steering in space, etc., have been answered. By artificial means all disturbing influences can be overcome. Speed is the only thing that matters, speed at the start, and of this factor actual experiment is the only satisfactory test. This I desire to accomplish, for I think I can prove the possibilities and safety of rocket propulsion.

In regard to my latest speed attempts on a rocket-propelled machine fitted with ski-runners, my plan to build this sled was conceived last autumn, when the mishap to the rocket-car at Blankenberg-am-Harz, on 3rd October, revealed to me that centrifugal force was a grave obstacle in relation to wheeled vehicles at high speed. So I built my first "Rak-Bob I" as a model two-thirds natural size, with a length of about 30 feet and a carriage measuring 30 inches square. On 22nd January a first attempt was made at Schleissheim, and despite the clogging snow, four simultaneously exploded rockets followed by a series of three rockets and a solitary explosion drove the sled at just over 68 miles per hour over a stretch of about 160 yards. As the weight of the sled was about two and a half hundredweights, this preliminary experience proved the theoretical possibilities.

These experiments, even if not giving spectacular results, were exceedingly valuable as indicating necessary constructional changes. I altered the position of the rocket batteries for one thing and the

*See "Europe—America in Two Hours?" (June, 1927); "Can We Fly to the Stars?" (July, 1928). By Max Valier.



THE ROCKET SLED THAT CHALLENGED THE WORLD'S MOTOR SPEED RECORD.
Diagrammatic sketches of Herr Valier's rocket-sled, with which in February last a speed of 249 miles per hour is claimed to have been attained. This speed is nearly 20 miles greater than Major Seagrave's motor racing record.

curve of the skis for another, and a further experiment was carried out on 3rd February at the Winter Sports Festival on Lake Erb. My wife—the first woman in the world to make a journey by rocket—took her seat in the sled, which was charged with six rockets; these were exploded in series of two at two second intervals. About 25 to 30 miles per hour was attained. Then I drove the sled myself over a stretch with twelve rockets, and within three seconds of the start more than doubled the speed. The third attempt with the sled unmanned, but fully loaded as arranged, in order to test the greatest possible speed, was postponed on account of the lateness of the hour. Eventually it took place on Lake Starnberg on 9th February with my new "Rak-Bob 2," embodying the structural improvements of my first experiences. The ice was crowded with spectators who could scarcely be held back by the police. The inquisitiveness of the people hindered my efforts considerably, and placed me at a disadvantage. The rockets were fired in series as before, but at 1½ second intervals; between the first and second discharge the sled made 25 yards, between second and third 65 yards, between third and fourth 105 yards, and eventually just under 120 yards were covered in 1½ seconds between the fourth and fifth discharge, a speed of 135 miles resulting. Following the explosion of the fifth series of rockets, the speed averaged nearly 235 miles per hour; the last 70-75 yards, however, were under brake control, so actually the highest speed was nearly 249 miles per hour. Unfortunately, the braking was not sufficient, and the rocket sled ran off the track into a pile, and damaged its nose. However, the experiment proved that very great speeds are attainable, and at low cost of apparatus. The sled and rocket machinery cost £75, while the cost of Major Segrave's car in which he made the world record was in the region of £20,000.

Of great interest from the technical standpoint was the fact that the inspection of the track revealed that after the explosion of the third series of rockets, marks of the fore-skis were scarcely perceptible, while the back guide dug deeply into the snow. This, however, was different after the fifth explosion, when the sled travelled evenly and lightly over the surface, and the high speeds were possible on account of the lack of friction.

My new project is to fly a rocket-propelled machine over the Channel between Dover and Calais, and this I hope to accomplish during the summer. For the purpose I propose to build a craft on hydroplane lines, with plane surface. The wings will serve another purpose than actual support in flight, and will be attached so as to enable special manoeuvring. For the start these will not be required, but at the apex of

the trajectory will come into use as stabilizers; then on descent the plane surface will be essential to allow safe landing at reduced speed.

During recent months I have been engaged in testing out various apparatus in order to find the correct form for the new construction, and I believe I am near complete success. Though it is necessary to some extent to be silent in regard to exact details, the rocket-aircraft itself will be in appearance like an arrow or harpoon, and its length about three times as much as its wing-span. The long body will be utilized as a tank for the propellant material, in such a way that the centre of gravity of the fully loaded machine, ready to start, will be greatly to the rear and the power of the rockets exerted as far as possible from the centre of gravity. As the thrust will be immensely greater than the weight of the machine, the apparatus will be able to rise without the aid of planes, just as if it were indeed an ordinary rocket. Yet absence of wing surface will be a disadvantage when landing, and therefore planes, though of unusual form, will be fitted to the rocket-propelled craft. On rising from the ground, the wings will be practically a useless attachment to the body of the apparatus at this stage, hence they must be fitted so as to offer the least resistance to the air.

When the machine arrives at the point of horizontal flight the wings will be brought into play to a modest extent, acting as stabilizers at high speeds. Descending, and on landing—the machine being now empty of fuel and therefore much lighter—the planes will have a greater part to play, increasing in effect as the flying speed decreases. Their manipulation and service will allow of a low landing speed, and enable the apparatus to drop lightly on the ground.

THE TRIAL ON LAKE STARNBERG.
Great crowds assembled to see the author try out his rocket-sled, the exhaust smoke of which is seen in the background.

THE ROCKET-SLED IN ACTION.
This photograph, taken after the first battery of rockets was discharged, gives a good idea of the tremendous speed attained even at the start.

This state of control can be obtained when the wings are so fitted that their position and influence may be changed to the widest extent. This will be a characteristic feature of the rocket-propelled flying machine.

In considering the path of flight I must first calculate the trajectory of a shell fired from a gun to travel about twenty miles, then assume the trajectory of the rocket machine to be laid rather flatter, but still very high in comparison with the arc of ordinary aeroplanes over the same stretch. The first part of the stretch would be covered with the rocket motor at full charge, so that coming into straight flight a great speed would have already been attained, say over 200 yards per second; if the motor be now shut off, the machine would, like a catapulted stone, fly further on a parabola and (ignoring the wings) come down at a point which gives a short landing. Actually, however, on the second discharge the pilot would reduce his power to half only, and by sharp steering come into horizontal flight without loss of speed. At the top of the flight the pilot would increase his fuel to full charge again until all his explosive was exhausted. From this moment air resistance would begin to have noticeable effect, braking the machine, and the planes would be brought normally into service; the flight would become a glide to landing. With a speed of just four hundred miles per hour, the Channel flight would take three to four minutes. Naturally, this cannot be done at the first attempt, and only after experiment and some risk will the flight be possible. The risk I am prepared to take, and I have not the slightest doubt that the Channel can be successfully "rocketed" in my proposed craft.

The Giant Forests of the Amazon.

By R. Ruggles Gates, M.A., Ph.D., F.L.S.

Professor of Botany, King's College, London.

All other forest areas are dwarfed beside the enormous belt which surrounds the Amazon River right across the South American continent. Much research remains to be made on the many unique species of vegetation.

DURING a recent summer I made an expedition up the Amazon River, to study its vegetation and bring back museum and herbarium materials. The farthest point reached was Teffé, 1,370 miles from the mouth. A week was spent here, making collections and taking photographs and cinema film, in the vicinity of the village which Bates made famous to naturalists under the name of Ega. Regions near Para, the port of entry for the Amazon, are, however, just as wild and luxuriant as any found farther inland; and in ascending and descending the river stops were made for shorter periods at many places, some of them on paranás or small lateral tributaries off the main river. An account of the expedition was published elsewhere, in my book, "A Botanist in the Amazon Valley" (Witherby), but I may here describe some features of the vegetation, and especially certain of the more characteristic and interesting plants.

Nowhere is the Amazonian vegetation exceeded in luxuriance. From the Atlantic to the Andes this vast waterway is only a few degrees south of the equator and its enormous drainage area, including nearly half of the South American continent, is for the most part covered with tropical rain forest. All other forest areas are dwarfed beside it. Northern forests give no conception of the wealth of species it contains. The multitude of species of trees and their adherent epiphytes, climbers and lianas striving for space and sunlight under conditions in which growth never ceases, kindles the imagination to realize the intensity of the struggle for existence and fills the landscape with every shade and shape of greenery. A feature of these forests less well known is that every year as the tropical rains swell the great river and its tributaries thousands of square miles of forest are inundated to a depth of perhaps twenty or thirty feet for several months. These inundated forests are called *igapo* (Fig. 1), and paddling a canoe through an igapó, between submerged tree trunks laden with every sort of hanging foliage shutting out the sky, is an eerie experience.

FIG. 1.
IN THE FLOODED FOREST.
The Amazon forests are flooded for thousands of square miles every year after the tropical rains, so that the tree trunks are submerged up to their foliage.

The flora of Brazil has been very incompletely described in forty folio volumes, so that all I can do is to refer to a few of the more characteristic types of vegetation which the traveller sees in passing up the river, and to mention interesting features of a few of the plants. Where northern forests have a few different species of trees extending over large areas, Amazon forests contain hundreds of tree species within an acre or so. Were they commercially available, woods with almost every conceivable property would be found here. Balsa wood (*Ochroma lagopus*), the lightest of all woods is used by the Indians for

FIGS. 2 AND 3.
CONTRASTED SPECIES OF PALM TREE.
In the left hand photograph are seen the slender Assai palms, the most graceful of the Amazon species. On the right are the Royal palms which by contrast have massive trunks, with a dull grey surface that makes them look like pillars of cement.

making rafts. The so-called cedar wood (Cedrela) exported for making cigar boxes has a specific gravity of 0.58. Pau santo (*Zollernia paraensis*), on the other hand, is nearly black and sinks like a stone in water (sp. g. 1.33). One of the hardest of woods is ita-uba (*Silvia itauba*), used in building wharves. Another wood, so hard it will turn the edge of an axe, is the acari-uba (*Minquartia guianensis*). It will resist decay in water indefinitely and is used for telegraph poles and similar purposes in Manaos because ants will not attack it. This tree has the unique feature of growing with peculiar longitudinal slots or holes in the trunk.

Amazon woods vary remarkably in colour. Marupá (*Simaruba amara*, sp. g. 0.5) is white, very light, and is used for making sabots and matches. It is extremely bitter to the taste and ants will not touch it. The wood of the mulatto tree (*Calycophyllum spruceanum*) is nearly white, but the shining golden brown bark gives the tree its name and makes it conspicuous in contrast with many others, which often have a dull grey bark with smooth or somewhat granular surface. So common is this type of bark that the natives often distinguish them by hacking it off and smelling the fresh wood. Odours of ginger and many other unexpected substances are determinative of these woods. Pau amarello (*Euxylophora paraensis*) is a beautiful yellow wood, often used for flooring in alternate strips with acapu (*Vouacapoua americana*), which is black when polished. An abundant wood near Obidos is muiracatiara (*Astronium Le Cointei*), which is beautifully striped with dark brown, reddish and golden colours verging into each other. Other woods are pure red or even brilliant purple, but even to enumerate their astonishing variety would exceed the limits of this article.

The traveller from a northern climate to the Amazon is perhaps first struck with the palms. This family of plants numbers about 1,500 species in the whole world, and of these over 800 are found in the Amazon region. The assai (*Euterpe*) is the most slender and graceful of them all. There are two common species, one (*E. precatoria*, Fig. 2) with single trunks and the other (*E. oleracea*) with the trunks in groups or clumps. The process which produces these clumps is the same as the tillering of wheat. There are several other

species of assai, all native to tropical America. Their fruits are used to make wine and also as a flavouring. The Royal palm (*Oreodoxa regia*) by contrast has a massive trunk (Fig. 3) which looks in close view exactly like a pillar of cement, for the bark is dull grey with a finely granular surface. Stately avenues of these trees are grown in the cities. A very different palm is the bacába (*Oenocarpus bacaba*), which has a very smooth trunk and the fruits hang in great clusters of grape-like blue berries on bright red stalks. The natives cover these bunches on the trees in the forest with a cloth, to prevent them being eaten by birds before they are ripe. Some of the palms, such as the mirity (*Mauritia flexuosa*) occur in groves together, especially in the lower part of the river, but others are more scattered in their occurrence.

FIG. 4.
THE MUNGUBEIRA.
This tree is found only in the Amazon area and loses its leaves while the fruit is maturing. Parrots break open the ripe fruit.

The túcuma and a number of other palms have their trunks covered with rings of long spines two inches in length. The paxiuba is not only remarkable for its thorny aerial roots which are used by the natives as rasps, but one species (*Iriartea ventricosa*) has a remarkable swelling half way up the trunk. The leaf petioles are rigid and are used by the Indians as small arrows, poisoned with curare and blown from a blow-gun. The urucury palm (*Attalea excelsa*) has a short trunk and a crown of huge, nearly erect leaves. It is common up the river and its fruits, which are about three inches long and covered with a thatch of fibre, are considered the best for smoking rubber. They yield about 45 per cent of a colourless, edible oil, and it is this fatty smoke which produces the desired effect in coagulating the rubber latex.

There are numberless other species, but I will only refer to three more: the peach palm or pupunha (*Guilielma speciosa*), which has large fruits with a yellow, mealy flesh when boiled; the murumuru (*Astrocaryum murumuru*), the nuts of which are shipped to Italy in quantities for making margarine; and the wax palm or carna-uba (*Copernicia cerifera*), which grows in higher dry ground. Its leaves are coated with wax, which can be shaken off. The leaves are also braided into hats.

Mention may be made of a few of the fruits found on the Amazon, many of which are quite unknown outside their native home. The caju, *Anacardium occidentale*, is one of the best. It grows on a small tree no larger than a hawthorn and is unique in that the fleshy part, shaped like an inverted cone, is the thickened end of the stem, and set on end at its flattened apex is the dark kidney-shaped nut. The fruit is red or yellow when ripe, and its flesh has a peculiar sodden texture, but the flavour is excellent. Cupuassu (*Theobroma grandiflorum*) is a very large oblong fruit with a velvety brown skin. It belongs to the same genus as the cocoa tree, also a native of tropical America. It is indigenous to the Tocantins and Xingu, two of the less explored tributaries of the Amazon, and the fruit is eaten or used in flavouring cold drinks and ices. Guava, known the world over as a delicious jelly, is derived from a small native Myrtaceous tree (*Psidium guayava*). When ripe the fruit is yellow, and there are two varieties, one having round fruits with red flesh and the other bearing elongated fruits with white flesh. A nearly related species called araça has a more tart flavour and before the fruit is ripe it has the appearance of a large green apple.

The genipape (*Genipa americana*) is a rubiaceous tree of moderate size and is frequently grown alongside the palm-thatched huts. The fruits have a greyish-brown velvety skin and a brownish flesh like that of a baked apple. Its juice is used by the Indians to paint

their skin. *Casepara* is the name given to another remarkable fruit which grows on a very large forest tree. The tree has a white latex with bitter taste and has been planted in some places, but I only saw it once. The fruit is as large as a plum, orange yellow in colour and with a sweet taste. Guaraná must be mentioned, although the seeds rather than the fruits are used in making a pink, slightly effervescent and non-alcoholic drink. The plant which furnishes the seeds is a native climber (*Paullinia cupana*); the seeds are pounded up and then compressed into masses which are the colour of chocolate. The drink is made by scraping some of this into a glass of water.

The Brazil nut tree (*Bertholletia excelsa*) grows to an enormous size and is round-topped with a dense foliage of dark green shining leaves. It grows in the depths of the forest and large numbers of the "nuts" are enclosed in a hard, thick-walled, nearly globular casket which crashes down from the lofty branches when ripe and is quite capable of cracking the human skull. To the same family (*Lecythidaceae*) belongs the sapucaia, some species of which produce their nuts in a still larger woody-walled structure like an urn with a lid, which bursts off and lets the seeds clatter to the ground. Another member of this remarkable South American family is the cannon-ball tree (*Couroupita guianensis*), which the Portuguese call the castanha de macaco, or monkey chestnut. The flowers of this tree are produced in great abundance. The

Fig. 5.
THE CAIAUE PALM
Like the Mangubeira, this tree also is native to equatorial America. Ferns are seen growing in the crown of huge leaves which surmounts the short stem.

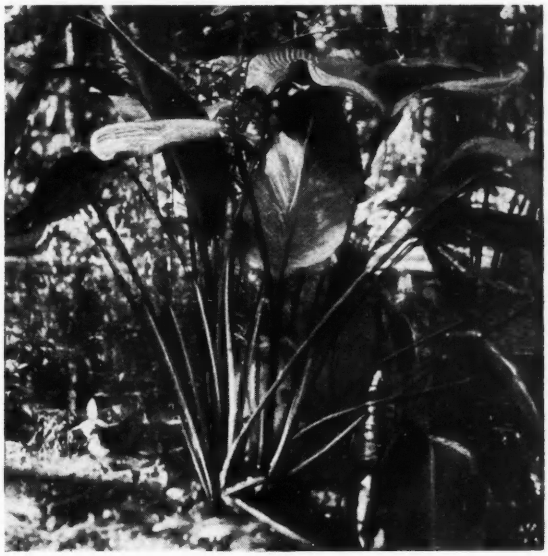


Fig. 6.
A PAPER PARCEL TREE.
Another Amazon native, *Ravenala guianensis*, whose large banana-like leaves are used instead of paper for wrapping up parcels.

petals range from dull red, crimson and lilac within to white, yellow and rose without. The flowers are of remarkable structure with a helmet-like arm bearing two kinds of stamens, one of which is gigantic in size and also as regards its cells and pollen grains. This tree sends out from its trunk and branches long stalks bearing many flowers, and the terminal one usually develops into a fruit which is filled with pink pulp. The wall is thin but hard, brown in colour, and round like a cannon-ball, about six inches in diameter. A tree in fruit with "cannon balls" hanging down its trunk and main branches from stalks several feet long is a very striking sight.

Reference may be made to one other family of trees characteristic of the Amazon—the Bombacaceae. The giant of the Amazon forests—*Ceiba pentandra*, the sumahuma or kapok tree—belongs here, but is also found in Africa and further East. This family has the deciduous habit even in the tropics. A related tree found only on the Amazon is *Bombax munguba*, the mungubeira (Fig. 4). Although much smaller than the kapok tree, its brick-red, oblong fruits are much larger. While these are maturing the tree is nearly or quite leafless. When ripe, the fruits are broken open by flocks of small parrots. To each of the innumerable seeds is attached a little parachute of dainty ecru floss which floats the seeds through the air when they escape the birds. This tree is only found along the water's edge, and the seeds germinate at once when they fall on damp soil. The bark of

this tree is also remarkable in that it shows alternating vertical strips of grey and green which are extremely tough and are cut into thongs for tying up heavy parcels.

The native Para rubber tree (*Hevea brasiliensis*) must be briefly mentioned. It grows interspersed with hundreds of other species in the forest, and the primitive methods of tapping lead to the development of protuberances on the bark, as shown in the figure. It lives in swampy conditions and the collection of the latex by the rubber gatherers in the wild jungle is a matter of great difficulty and hardship. A number of other species of Hevea yield rubber of poorer quality.

There are a number of "cow trees" which yield a latex having considerable resemblance to milk. The sorviera (*Couma macrocarpa*) has a dark, rough bark. When this is slashed with a heavy knife, large milky drops flow out. They have the consistency of cream and are sweet to the taste. In fact, they strikingly resemble condensed milk and are used by the natives in their tea. When coagulated, the latex forms a solid mass known as breia which is used for caulking boats. Another "cow tree" is massaranduba, a name given to various species of Mimusops producing the latex from which balata is made.

Finally, one or two plants may be mentioned which are interesting in their relation to problems of distribution. One of these is the caiaue palm (*Elaeis melanococca*), shown in Fig. 5, with a mass of epiphytic ferns growing in the crown of huge leaves which surmounts the short stem. This tree is native to equatorial America. The only other species of Elaeis is the well-known oil-palm of western Africa (*E. guiniensis*). This and similar cases of distribution could be easily explained if, as Wegener thinks, South America broke away from Africa and floated westward like an iceberg on the lower layer of the earth's crust. Another somewhat different case is that of *Ravenala guianensis* (Fig. 6), which is native to the Amazon valley. It has large banana-like leaves which are used instead of paper for wrapping up parcels. The only other Ravenala known is the famous traveller's tree, *R. madagascariensis*, found only in Madagascar.

In concluding, I may note a few of the plant associations which occur along the edge of the great river and its innumerable branches. One called oeirana consists chiefly of the single willow (*Salix Humboldtiana*) found on the Amazon. As a small tree it occurs as a fringe on mud flats, its pale green leaves intermingled with those of a Euphorbiaceous tree of very similar appearance. Another is aninga (*Montrichardia linifera*), a giant aroid whose soft stems often form a palisade in the mud, to the exclusion of other forms. Canarana is the name given to a very characteristic plant formation consisting chiefly of coarse, floating grasses with their rhizomes anchored in the mud. Mingled with these are numerous floating water plants, such as Eichhornia and the water ferns Salvinia and Azolla, as well as Utricularia and numerous other forms. When the Amazon rises in flood, thousands of acres of canarana is torn loose from its moorings and carried down stream as "floating islands," mingled with uprooted tree trunks; for thousands of miles of soil are washed away by the floods every year and plantation owners within the vast flood areas have no sense of security or stability from year to year.

Modern Industry "On the Films."

U.S. Government Production.

One of the most attractive institutions in the world now studying industrial problems is the U.S. Bureau of Mines at Washington. The following, based on official reports, describes a new series of educational films designed to show the latest processes in metals and oil, and also to emphasize safety precautions.

DIZZY rides in aerial trolleys, descents into the depths of mines, and wearisome journeys across trackless desert have been undergone in the making of a wonderful library of cinema films, under the auspices of the United States Government. To illustrate the mineral and allied industries of the American nation, these films have been made in the almost unbearable heat produced by metallurgical furnaces and also in the frigid temperatures of the frozen Far North. Thousands of miles have been travelled by land, air, and water, and the photographers worked also in underground mine passages, where progress could be made only by crawling on hands and knees. In one case imprisonment in foreign lands was even experienced. The result of all this effort has been the production by the Bureau of Mines, at Washington, of what is believed to be the largest collection of industrial films in the world. The Bureau now

possesses 525 sets of films, consisting of 1,411 reels. If these films were unrolled, their total length would exceed 250 miles.

The plan of this great enterprise has been to show plainly, both to the engineer and to the man in the street, the workings of the many and varied American mineral industries, which employ over two million men and produce more than £1,200,000,000 of products annually. The underlying purposes have been to teach lessons of safety and the conservation of the nation's natural resources. The cost of producing these films has naturally been heavy, but has been borne entirely by various industrial concerns, except for the salary and travelling expenses of an engineer of the Bureau of Mines staff. As the films bear the government stamp of authenticity and impartiality, the mineral and allied industries have co-operated to the fullest extent in the work of production. Special structures have been built, and in many instances extra mining crews have been provided and equipment installed, in order to produce the effects desired. Professional film actors were sometimes employed, although the Bureau depended largely on amateur actors in the various localities visited.

The Story of Petroleum.

Quite a number of the films picture the workings of the great petroleum industry. In making the seven-reel film "The Story of Petroleum," the principal oil fields and refineries in every oil-producing State were visited. A special pipe line was laid across the Mississippi River for the sole purpose of illustrating this construction. In order that no trade mark or the name of any particular company should appear in the pictures, it was necessary on many occasions to paint over oil tanks, cars, and other equipment. In one instance several hundred tank cars were painted so that no trade name would appear on them. For a film called "Through the Oil Lands of Europe and Africa," a photographer visited all the principal oil fields of continental Europe and also penetrated into the Sahara Desert. In some of the remote districts he was more than once thrown into jail by suspicious officials, and released only after intervention by the American Consul. While obtaining certain scenes, he also enjoyed the experience of being shot at by sentries, and more than once his films were confiscated by customs officials.

When it was desired to photograph the coming in of a great oil "gusher," it was necessary for the camera man to stand by his machine for a period of five days, to make sure of photographs when this big source was struck. Scenes taken in this way are included in the film entitled "Through the Oil Fields of Mexico," which shows the drilling of oil wells in the jungles and the various stages in the transport, storage, and refining of petroleum. The location of the principal Mexican oil fields is made plain by the use of specially-drawn maps. The first scenes show what has been called the "Hill of Tar," where the seeping of oil through the surface first called attention to the petroleum possibilities of Mexico. Next follow scenes of the Cerro la Pez well, the first commercial oil well in Mexico, which attracted the pioneers of the industry. A picture of the first oil-burning locomotive to be operated in that country is also shown.

Oil "Gushers."

Views are presented of the Cerro Azul camp on the site of one of the richest oil pools of history. Here it was that in 1916 the Cerro Azul No. 4 well was drilled, probably the most spectacular and best-known oil well in the world. Other scenes show the famous Potrero del Llano No. 4 and the Dos Bocas wells. The first-named well ran wild for a period of nearly four months, much of the oil finally being saved by the construction of a dam across a tropical river. The total production of oil from this well amounted to 110,000,000 barrels. Its rejuvenation long after it was considered exhausted and when its equipment was buried under masses of debris, is shown in a series of striking scenes. Perhaps the best section of the film shows the "bringing in" of a great oil gusher in a southern Mexico field. The actual spouting is seen of a tremendous flow of oil, which destroyed the top of the derrick and hurled aloft two tons of drilling tools with such force that on falling they were buried twenty feet into the ground. This great geyser of oil is brought completely under control within the space of ten minutes by modern equipment

In addition to the Mexican pictures this film shows an absorption plant used in the extraction of petrol from natural gas, the laying of oil pipe lines, and the storing of crude oil and refined products. A plant for the manufacture of sulphuric acid, used in large quantities in purifying processes, is also shown. One-and-a-quarter billion barrels of oil have been produced in Mexico and one and one-half billion dollars, much of which is American capital, have been spent by the industry in the recovery and handling of Mexican petroleum.

In making films pertaining to the iron and steel industry, when it was desired to obtain scenes of the interiors of furnaces containing metal, it was at times necessary to use sheets of asbestos to protect the camera and operators from the intense heat. On some

occasions their clothing was actually set on fire by the flying sparks from the furnaces and forges. In steel mills the heat was often so fierce as to melt the emulsion on the film itself. While photographing scenes in Alaska for "The Story of Copper," the cameraman took hair-raising rides on the aerial trolleys that stretch across the valleys. At the other extreme, some of this film was taken thousands of feet underground. Lighting equipment of a capacity of 12,000,000 candle power was used, and owing to the great heat generated by the arc lamps, the operators frequently worked in temperatures almost unbearable. To obtain this film a journey of approximately 25,000 miles was made through Alaska and the principal copper-producing States.

Explosions Photographed.

For other pictures that included the use of explosives in firing tremendous blasts, special structures were built so that the photographers could obtain "close-up" scenes of these operations. On many occasions large quantities of earth and rock were thrown upon these structures by the blast. Despite the risks involved in the making of the films, there has never been an instance of injury to a member of the crew. The Bureau of Mines is the apostle of safety in mining, and practices its safety doctrines in all its own activities.

To view the industrial films prepared by the Bureau is itself a liberal education in the practical workings of industry. One sees the diamond drill sinking hundreds of feet into the earth and bringing forth samples of the rock or ore that lie below; next the mining of sulphur is shown, from deposits at a depth of 1,000 feet. This is effected by means of compressed air, which forces up the sulphur previously liquefied by super-heated water pumped down from the surface. Again one sees the flow of white-hot molten iron in the making of 500-pound ingots. One marvels at the use of the spreader plough, which does the work of many men, and at the wholesale change wrought in the earth by tremendous blasts of dynamite. A wealth of information is offered about the manufacture of materials used in everyday life. Thus the use of sulphur is shown in the making of explosives and paper, the use of steel in wire, and of asbestos in the manufacture of roofing and motor brake-linings.

Though the films were for the most part made in the United States, many scenes have been taken in foreign lands, for instance of mining asbestos in Quebec and of the movement of oil barges on "the blue Danube." Quaint glimpses of foreign life and customs are thrown in for purposes of background, and one sees the ruins of Grecian temples, the Egyptian pyramids, and the romantic Grand Canal of Venice. As a contrast to modern industrial methods, many scenes depict those of bygone days. Ancient devices shown include the use of falling water for power production; early methods of transport; the discovery and first harnessing of electricity; and primitive methods of heat-treating steel. Where ordinary photography does not answer, animated photography or "cartooning" is employed to show, for example, the internal workings of an automobile engine.

A film dealing specially with this subject is called "The Power Within." By illustrating the proper care of the internal combustion engine, the film is designed to conserve petrol and lubricating oils, two of the most important products of American industry. The construction and operating principles of various types of engine are visualized in pictures of cut-away engines, showing quite clearly just what happens in the mechanism when the driver puts his foot on the accelerator. The working of other important operating parts, such as the transmission, differential, and ignition system, is also included.

In line with the "safety first" activities of the Bureau of Mines, a number of films emphasize safety in the mining and petroleum industries. One particularly dramatic film, "When a Man's a Miner," outlines in fictional form the story of "Lucky Burns," a careless miner, who, after incurring an accident, takes up the study of safety methods, and is later on able to save his fellow miners during a mine explosion. A series of thrilling scenes depicts the panic in the underground passages after the explosion, the building of a barricade by the entrapped miners under Burns' direction, and their final rescue.

Interest Abroad.

The Bureau's films have attained great popularity, and in a recent three-month period they were viewed by 665,000 persons. Exhibitions have been given to educational institutions and at military centres, as well as to miners' unions, chambers of commerce, and other organizations. The fame of the films has spread abroad and recently the Japanese Bureau of Social Affairs purchased four of the safety films, to be used in the course of an industrial safety campaign in that country. Again the Quebec Safety League bought copies of the film on "Carbon Monoxide" and arranged for it to be shown in almost every picture theatre in the Province. The chief distributing centre of the films is the Experiment Station of the Bureau of Mines at Pittsburgh, Pennsylvania, and no charge is made for their use other than cost of transportation.

The Exploitation of the Dead Sea.—II.

By I. Melamede.

Concluding from the April issue his account of the Dead Sea scheme, on which he has been working in Palestine, Mr. Melamede deals with economic factors. The chemical refining is first discussed.

Of the salts to be obtained from the four evaporations, the mass of carnellite from the second series of basins is the most important product and the only one which will be exploited at the beginning. Transport prices permitting, a considerable portion of this salt will be despatched and sold in a raw form as 20 per cent fertilizers. But it is likely that the high transport prices will force those in charge of the Concession to purify the whole of this production, with a view to obtaining a purer product containing 80-95 per cent pure potassium chloride, a very valuable product which can bear the highest transport expense. In this latter case the carnellite will not even be transported, but will be treated in the same basins with a view to obtaining the purer potassium chloride. To this end it will be sufficient to treat the whole mass of salts contained in the basins with cold pure water, which will then dissolve the impurities and after evacuation of this water there will remain a potassium chloride which will mark a purity of 80-95 per cent. This purification process depends, of course, upon a sufficiently large quantity of potassium chloride; but the resources of the Dead Sea are so colossal and the production of the carnellite so easy and inexpensive, that there will be no difficulty in carrying it out.

Purity of Products.

It must be noted that opinions vary as to the production of this final pure product. German scientific quarters in particular maintain that the artificial carnellite from the Dead Sea will not, in view of its chemical composition, lend itself to the necessary process of purification, and on the strength of this assumption they have questioned the value of the whole scheme. These theories—and they are nothing but theories—have fortunately not been confirmed. All tests hitherto made and performed at the Dead Sea have favoured the reverse theory. Major Brock obtained a final product containing 80 per cent pure potassium chloride; Mr. Blake, on behalf of the Government of Palestine, obtained 88 per cent; while Dr. Bobtelsky, of the Hebrew University of Jerusalem, from a special study of the question obtained a product containing 99 per cent of pure potassium chloride.

As regards the whole scheme—in which at least three complete cycles of evaporation are anticipated to be possible annually—when the number of cycles has been definitely fixed the quantities to be produced will then depend only upon the surface of evaporation available, that is, upon the number of basins used or constructed. Ultimately one is justified in anticipating an annual production of 100,000 tons of potassium chloride. With each ton of potassium chloride are 5 tons of sodium chloride, hence there will be produced at the same time 500,000 tons of sodium chloride. These two chemicals, as already stated, will alone engage attention at the beginning. Potassium chloride will be immediately exported, sodium chloride will only be exported if transport prices will permit. Otherwise it will be stored on the spot, with the other products magnesium chloride and magnesium bromide, to await the establishment of special workshops to deal with them chemically.

In the near future it is anticipated that there will be a production of 1,000,000 tons of potassium chloride and consequently 5,000,000 of sodium chloride, accompanied by immense quantities of magnesium chloride and magnesium bromide. With the exception of potassium chloride and part of sodium chloride, all salts will be treated on the spot, when there will be established an important electro-chemical industry. This will insure in the first place the extraction of bromine, chlorine and caustic soda, which in turn will permit the preparation of the bulk of the salts enumerated above.

Electric Power Schemes.

The electro-chemical treatment of salts will necessitate a large quantity of electrical power; here again Nature aids the chemist, and the unique geographical position of the Dead Sea will be exploited. Already under the direction of Mr. Rutenberg, the celebrated electrical engineer who has undertaken to electrify the Holy Land, a group is working on this job and is electrifying and irrigating the country by the otherwise useless waters of the Jordan. Under the scheme there will be 100,000 horse-power, which will amply answer the needs of Palestine. Within

two years the Palestine Electric Corporation Ltd.—the technical name of the Rutenberg Concession—will complete the first electrical plant with a power of 20,000 horse-power.

The above figures, somewhat perplexing even to the scientist, are not introduced in such abundance to prove an academic hypothesis; they are intended to demonstrate the practicability as well as the economic possibilities of the exploitation of the Dead Sea. On the face of it the figures would appear to indicate a profitable scheme, but from its being a possibility to its becoming a success there is an appreciable ground to traverse. Its success, as already stated, depends upon the two main and inseparable factors—transport facilities and the international market.

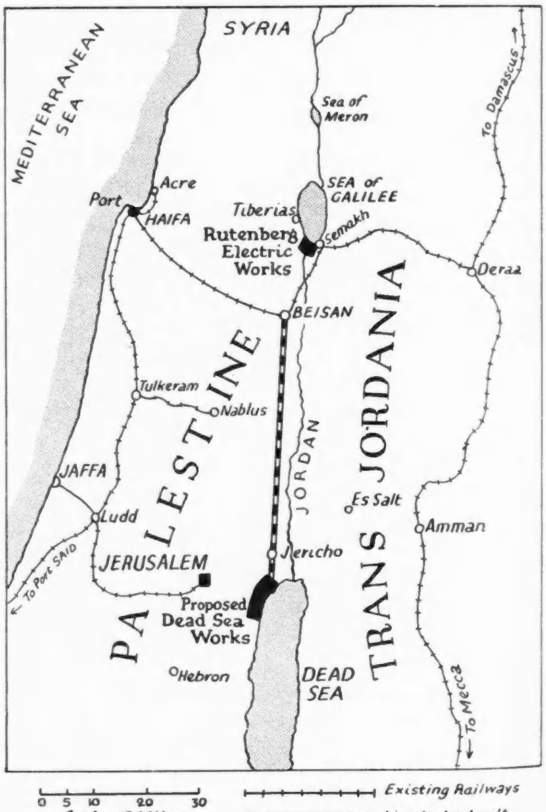
The Transport Problem.

The Dead Sea is located at the very short distance of 80 kilometres from the Mediterranean coast; yet the transport there of the salts produced constitutes a serious problem. The port of Jaffa—if port it may be called—the Jaffa of Jonah fame, is by direct line the nearest point on the Mediterranean which could come into consideration for the mineral transit from the Dead Sea. But the Government of Palestine has decided upon Haifa, which is to rival seriously more powerful harbours in the north and south as the future harbour of Palestine. It is to Haifa, therefore, that we have to turn in any discussion of the transport facilities which are to serve the products of the Dead Sea.

There are two separately managed railway systems in Palestine; there is the Syrian line, Haifa-Beisan-Damascus, and the Egyptian line, which was built by the English troops largely during the war and runs from Haifa to Jaffa and Port Said, there meeting the lines of the world's most important junctions. This latter line has an important branch line linking it with the City of Jerusalem. Now Jerusalem itself is connected eastwards with the Dead Sea and the country east of the Jordan by an adequate motor road to Jericho and the Dead Sea. But any attempt to link the city by a railway is doomed to failure, as the Dead Sea is at such a low depression while Jerusalem is on the hills at an elevation of 2,600-3,000 feet above the sea level.

Hence the authorities in Palestine have decided upon a railway to link the Dead Sea area with Beisan; an up-river railway line, which will run parallel to the Jordan. Its length will be 84 kilometres only, while its estimated cost is about £600,000. The line will then be linked with the Syrian system. When the harbour at Haifa has been constructed, the problem of transport to the Mediterranean will have been solved. The immense output will be carried in specially prepared trucks on the railway to Beisan, and might be loaded on the same day into great liners waiting in the Haifa harbour. There will be berthage facilities here for some of the largest Transatlantic liners in the world, and the size of the harbour is expected to be three and a half times that of Beirout, its serious and well-established rival in the north. But transport, and particularly local transport, is not everything required to make the scheme a success, it is only the first part of the translation of the great scheme into reality.

International market conditions are the more important factors which will determine the success or otherwise of the Dead Sea scheme; to them, and to them only, will the investor turn for enlightenment as to whether or not investment will be justified, or to whether, despite the apparent brilliancy of the



MAP TO ILLUSTRATE THE DEAD SEA SCHEME

figures, he would be putting his money on the wrong horse. Yet market conditions alone, with their perennial fluctuation and dependence upon a hundred and one economic and political factors, would appear to offer a doubtful guide in discussion of this kind.

Before the war the potassium monopoly was in the hands of Germany and since the war, under a French-German agreement, Germany is to furnish two-thirds of the world's requirements in potash, while France will furnish the remaining third. When we remember that the mines of Alsace and of Stassfurt are sufficient, and more than sufficient, to supply the world's requirements for another few centuries, it becomes clear that the Palestine production will have to embark upon a doubly difficult task. It must either seek new markets, or, no less difficult, compete with the German products of established repute. In the writer's opinion Palestine will be able to do both, as the following examination bears out.

As to competition, let us turn to a few figures for enlightenment. In 1925 the United States imported 240,000 tons of pure potassium chloride, valued at £10 a ton on exportation from Germany and £14 on receipt in New York. It has been calculated that the price of a ton of potassium chloride will cost £1 at the Dead Sea, and allowing the large margin of £7 for transport expenses to New York, we arrive at the figure of £8 per ton upon arrival in New York. Prophecies and advance calculations are admittedly dangerous ground on which to discuss economic possibilities; but as has been proved in the first article, by comparing operations and prices at Stassfurt and at the Dead Sea, it is right to infer that production costs at the Dead Sea will be considerably lower, which will make the product a serious rival to the Franco-German output.

Prospective Markets.

The question of sale in the first years of production, when the total output will not exceed 100,000 tons of pure potash, will not be a very serious factor in the economic discussion of the scheme as a whole. For that relatively small output will be easily absorbed by the neighbouring countries. But it will not be as easily solved with the increase of the output, especially when the production has reached the million ton mark. It will be then that Palestine will find it wasteful to direct its efforts solely to the competition of the German-French products and will have to turn its attention to procuring fresh markets. The authorities responsible for the welfare and prosperity of the Holy Land will have to "sell" the idea of fertilizers to future and prospective markets, with

SALT WORKS AT THE DEAD SEA.
This small plant is already operated right on the shore of the Dead Sea.

intensive propaganda for which there is still a large field. Suffice it to mention Mesopotamia, one neighbouring country of great fertility in the past and with potentialities in the future. Like Palestine, Mesopotamia has suffered centuries of neglect and desolation, and is an agrarian land which will need every possible encouragement for the promotion of its agriculture. The potash of the Dead Sea will therefore be a welcome stimulant.

The Dead Sea scheme is built on the hard facts of science and economics, but it will require a great deal more than the business acumen of the average investor. The results can be calculated to the last cent but will be impossible of realization as an ordinary going concern, without the vision, idealism and devotion of scientists which have translated the dry figures of the statistician into promising realities.

The exploitation of the Dead Sea is an inseparable ring in the great chain of Imperial undertakings and an inevitable page in the upbuilding of Palestine by the Jewish people. Opinion will always vary on the country as a Jewish political undertaking, but there can be no two opinions as to the economic rehabilitation of a land, once dear to all humanity and to this day held in sacred devotion by the civilized sections of the human race. The romance of it all is so obvious that no words can adequately describe it. The writer of these articles has not permitted himself to be dragged by the visions and sentiments of dreamers, but may he nevertheless sound a sincere note of hope and optimism in conclusion? May it be said that, without believing in Eldorados and in "booms," one is perfectly justified in looking forward to days truly great and prosperous for the Holy Land.

Do Dreams Come True ?

By A. S. Russell, M.C., D.Sc.

" An Experiment with Time " (A. & C. Black, Ltd., 10s. 6d.), is the title of a book about dreams, in which Mr. J. W. Dunne describes some remarkable experiences and advances a new theory. As the first edition recently attracted much attention, we invited Dr. Russell to review the new edition in the following article.

MR. DUNNE makes remarkable claims in his book, " An Experiment with Time." He claims that in dreams things can be seen which *afterwards* in waking life are found to occur. He supports this claim by describing events in his own life which are found to bear a close similarity to things seen previously in dreams. (For years he has carefully recorded his dreams on awaking.) He does not profess, as certain charlatans do, to be able successfully to predict future events ; he finds a very different, but still remarkable thing, that certain happenings in real life have been enacted before him previously in dreams.

[Photo : Bassano.

MR. J. W. DUNNE.

On its first appearance this book made a stir. Dr. Schiller said that any philosophy, not utterly effete, should feel it its duty to grapple with the stimulating questions raised by Mr. Dunne. Mr. Wells found it fantastically interesting. It was likened by a reviewer to " The Origin of Species " in its probable influence on mankind. The book therefore clearly demands attention. It matters enormously whether Mr. Dunne has or has not made out his case.

Let me give two examples of the kind of coincidences that Mr. Dunne has experienced. In 1904 he dreamed that he was walking along a pathway between two fields, separated by high railings, when suddenly a horse in the field on his left began tearing about in a frenzied fashion. A hasty glance along the railings convinced the dreamer that there was no opening by which the animal could get out. Somehow, however, the horse did get out, and began to chase Mr. Dunne down the pathway. The latter ran like a hare towards a flight of stairs at the end of the path, the horse in close chase as the dream ended. On the following day the scene he had dreamed was closely enacted in reality. He found himself between two fields with a fenced-off pathway running between. The horse, but much smaller than the horse of the dream, was there behaving as in the dream. The author ran his eye critically along the railings ; as in the dream, he could see no gap or even gate in them. He became satisfied that at any rate *this* horse could not attack him. But it did. It got out of the field, thundered down the path towards the wooden steps, plunged into a river, made for him, but did not, in fact, attack. Here indeed is a remarkable coincidence, if coincidence it be.

On another occasion the author dreamed that he saw a monoplane crashing badly in a meadow which he did not recognize. Out of the wreck there came to him one B., a fellow officer of the R.F.C., who in reply to a question said that not much damage had been done and that it was " all that beastly engine." The hour of the dream was fixed as close on 8 a.m. because Mr. Dunne was aroused from it at that hour. About three days later Mr. Dunne was informed that between 7 and 8 o'clock on the morning of the dream B. had been killed near Oxford ; a remarkable coincidence. But, it turned out, engine failure did not cause the accident ; B. was passenger, not pilot of the machine, and the death of the pilot, which was a fact, had not been observed in the dream.

These examples are two of many given by Mr. Dunne, and perusal of them all makes fascinating reading. The cumulative evidence in favour of close

correspondence between the events observed and the things dreamed is regarded as remarkable. Mr. Dunne says that if these dreams had occurred after the events they would have been passed over without remark (but is it true that we dream past events?); it is their occurrence before the events that has led him to conclude *that we may habitually observe events before they occur*, and to add that, if prevision be admitted, it is a fact that destroys the basis of our past opinions of the universe.

The New Theory.

In the second part of the book the author puts forward a theory in explanation of his experimental results. The theory is not easily followed, but broadly it is this (I follow an admirable summary of it in *Nature*, Vol. 119, p. 847, by Professor H. Levy): It assumes that our field of perception moves through time, and therefore its time-speed must be measured with reference to another and quite differently dimensioned "time"; that this "time" must likewise involve the existence of a third "time," and so on, giving what the author calls serialism in time. Similarly our conscious perception of events, perceiving ourselves perceiving, involves the existence of a sequence of observers (ourselves) with the conscious observer at the head of the sequence, another form of serialism. Every time-travelling field of presentation is contained within a field one dimension larger, travelling in another dimension of time, the larger field covering events which are past and future as well as present to the smaller field; all these are observable by the conscious observer at the head of the series. It follows that the "future" will be best observed when the mind is freed from the normal waking images, and this is what the author tries to do experimentally.

Such a strange theory as this (and it is as strange to most physicists and psychologists as it is to the ordinary informed reader) must wait till the experimental facts are unimpeachable. Are they unimpeachable? I, for one, think not.

We all of us have remarkable experiences of coincidences. Things happen to us in real life which would not be tolerated as coincidences in a novel. The explanation of them lies in the nature of the universe, our enormous capacity for experience, and our proneness to select from this experience certain happenings because they surprise us. It is astonishing, when a penny is tossed a great many times, how often in succession it may fall "heads"—up to thirty times have been recorded. No one regards this as more than chance; we do not alter our conceptions of space and time because of it. Another coincidence widely experienced is the constant cropping up of a new word or name immediately after it has been brought before our notice. For example, we are introduced to a Mr. Uddingston, a surname new to us. The same day we notice the name on a huckster's cart, in an advertisement for blacking, and at the bottom of a letter to the editor of *The Times*; the same evening it is mentioned on the wireless as a residential district near Glasgow. Again, every one who dreads the onset of a disease knows how often its name is brought prominently before him. In cases like these only the egoist thinks that the universe is orienting itself for his especial benefit; sensible people realize that such occurrences would have happened anyway, and passed unnoticed like thousands more, had they not been keyed-up to observe them. One who is keen on coincidences experiences more of them than one who is not, just as one who is keen on fresh air breathes more of it than one who is not. Again, largely unconsciously we are under the influence of our dreams. Isn't it part of our life to make "our dreams come true"?

If I dreamed last night that, while out rowing, I was stung in the neck by a wasp, and this afternoon, while out rowing, I was actually stung in the neck by a wasp, I must first of all rule out coincidence, and second an unconscious desire on my part to make my dream come true, before I need consider Mr. Dunne's the-future-has-already-been-observed theory, or bother about altering my fundamental notions of time. Each of us experiences hundreds of events daily, and dreams, not one thing, but many things nightly. That there should be occasionally fairly close correspondence between dreams and events over a period of years is, to me, not surprising. I agree that the closer the correspondence the more is this view of the matter unlikely.

Importance of Detail.

But in most of Mr. Dunne's examples there is no exact correspondence; the dream is a picture of the event, never a photograph. In the account of B.'s death in the airplane accident, B. was in fact killed; in the dream he was alive and talking about the accident, and the explanation of the accident was, in fact, as Mr. Dunne agrees, wrong. The central figure of the actual occurrence did not come into the dream at all. How close the meadow dreamed of by Mr. Dunne resembled the place near Oxford where the accident happened, we are not told. A meadow in itself has no coincidence value; the chance that a crashing airplane will come down in a meadow is probably high.

Again, in the story of the horse, which, to me, is a better one, Mr. Dunne says that the actual event, "though right in essentials, was absolutely unlike [the dream] in minor details." (Here one would like to know if the scene of the dream and of the subsequent event had been seen by the author before the dream.) But dare we waive detail? Isn't science mainly concerned with detail? It would be absurd to waive detail in identifying one man with another. It is not enough that they are of the same height, build and colour, or even, going to greater detail, that they have the same number of eyes and arms and feet. Why should two events, one dreamt and the other experienced, be regarded as the same on a less rigid standard?

There is one further point. It is strange that in this second edition the testimony of those who must have been induced by Mr. Dunne's example to repeat his experiments is not included. Mr. Dunne does not claim to have a special gift. Anyone who is honest and straightforward can try for himself and test Mr. Dunne's conclusions; the more testimony the better. Surely Mr. Dunne's next move is to get experimenters of standing, not cloaked by anonymity, to repeat his experiments and collate their results with his.

Progress in Travel: 1928-29.

As in previous years, this issue includes several articles of special interest to travellers, while below we publish notes on some of the facilities offered by British travel companies for the coming summer.

THE most spectacular development in travel during the year since the last "Travel Number" of *Discovery* appeared is undoubtedly the opening of a regular air service to India. The first flight over the new 5,000 mile Empire route was successfully accomplished in April, and already a mail service is in operation, by which for two shillings a letter may be sent to India in six days. Preparations had been in progress for some time, but not until certain diplomatic barriers as to flying over Persian territory were surmounted, could Imperial Airways offer a service both brief in duration and safe for passenger traffic. The recent political disturbances in India emphasize the value of rapid communication with the Dominion, though the new route will be equally appreciated by those with only a short time for holidays, such as residents and members of the Civil Service to whom it offers great advantage during official leave.

As is inevitable, however, the fares by aeroplane are still considerably in excess of those by steamer, and travellers to and from the Near East can take advantage of the lower summer rates offered on certain of the Peninsula and Orient vessels, as also on the Bibby Line service to Egypt. The difference between the cost of a passage to Marseilles and the longer journey to Egypt is so small that, apart from the pleasure of some days extra cruising in the Mediterranean, it is not surprising more people are every year making the longer trip. Those who travel overland are given many glimpses of ancient France on the Paris-Lyons-Mediterranean railway, which runs through the most picturesque spots in the South.

In connexion with aviation, but of quite different interest, is a week-end cruise which the Royal Mail Line has planned for those who wish to see the Schneider Cup race in September. The contest this year is being held in British waters, off Southampton, and a party leaving London on 6th September will spend the week-end on the "Araguaya," which will cruise in the Solent during the races. The competition involves flying over a course 218 miles in length, and from the liner the most favourable view possible should be afforded.

About the same date those readers who are members of the British Association will be on the return voyage from the South African meeting, which ends on 7th August. The opening proceedings take place in Cape Town on 22nd July, and after further sessions in Johannesburg and Pretoria, with visits to such industrial centres as the diamond mines at Kimberley, members will proceed on various excursions which the South African State Railways are organizing at reduced rates. Parties proceeding from London may travel by the Union Castle Line, which is offering special tickets, as also is the Blue Funnel Line. These latter ships proceed to South America, which is also reached by the Harrison Line, to Trinidad; cruises previously offered in the summer by this company have, however, this year been deferred until the autumn.

By way of entertainment on the outward voyage, visitors to the Cape Town meeting may amuse themselves by gaining some acquaintance with Afrikaans, which is spoken by the natives both in the

Union and in Rhodesia. Appropriately to the occasion, Messrs. E. Marlborough have published a pocket manual of Afrikaans, by Mr. L. Van Os, an official translator to the Supreme Courts in South Africa. The subjects in the classified conversations are arranged alphabetically and deal with currency and postal details, as well as the usual conversational matters.

"See the World" is the engaging title of a summer holiday programme issued by the Workers' Travel Association, Ltd. In 1922 this unique organization commenced by arranging holidays for 700 people, and now, mainly on personal recommendation, this modest beginning has been built up into an immense agency dealing with over 20,000 holidays a year. Equally remarkable has been the growth of the "cabin class" on Atlantic liners, both to Canada and the United States. Until recently the traveller was faced with the luxury of what has been called the "floating hotel" or alternately the crude accommodation of steerage. Realizing that in particular the academic world included many potential travellers, the Cunard and United States Lines, as also the White Star and French Lines, inaugurated the "one class boat," and during the summer months, at the close of the university year, several vessels are exclusively employed with this new passenger traffic. Those who have crossed the Atlantic both first class and by "cabin" facilities can testify to the remarkable comfort now offered by the latter, apart from the consideration that among the two categories the humbler travellers often provide more congenial company.

On the South Atlantic routes, an important development in the history of the modern motor ship was inaugurated with the sailing recently of the twin-screw passenger liner "Highland Monarch," on her maiden voyage to South America. This new vessel is the first to be completed of five similar motor ships ordered from Messrs. Harland & Wolff by the Nelson Line for their passenger, cargo and refrigerated produce trade between the United Kingdom, Brazil, Uruguay and Argentina, *via* Spain, Portugal and the Canary Islands. The new vessels, while maintaining the traditional characteristics of the Line, mark a notable advance both from the point of view of size and type of propelling machinery that has been adopted. The "Highland Monarch" has a displacement of 25,420 tons.

While the comfort afforded by the most modern liners, in particular those used for world cruises, becomes every year more remarkable, it is an equally notable sign of progress that travel for those of moderate means is also improving continually, both in character and scope.

Correspondence.

HORACE'S FARM IN THE HILLS.

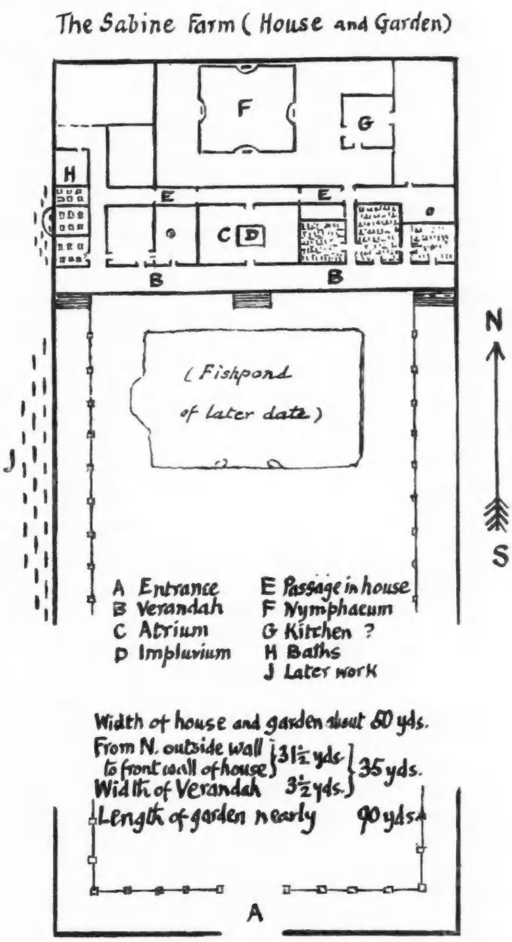
To the Editor of DISCOVERY.

SIR,

I have read with much interest the article contributed by Professor Conway to the March number of *Discovery*. My interest is all the greater as two or three years ago I had the pleasure of personally conducting the Professor over the Sabine Farm. One cannot but admire the way he continues to bring home not only to scholars but to a wider and less instructed world the services which the great Latin poets Virgil and Horace have rendered to civilization.

As to Virgil, I agree with Professor Conway that the traditional site of Virgil's birth, Andes, the modern Pietole di Virgilio, seems impossible. The whole tract is a flat alluvial bed from which not a hill, still less a mountain, can be seen.

The main subject, however, of Professor Conway's paper is not Virgil but Horace, and it is of Horace that I wish to speak in the few remarks I am making. I write from the Villa d'Orazio



at Tivoli, the home of the poet's later years (as it is of mine), and the home of my wife's family for just fifty years.

I first visited the site of the Farm over forty years ago, when all that was to be seen of the house was a bit of mosaic pavement which the farmer uncovered for us. The rest of the house and garden lay still hidden under a vineyard.

Professor Conway notes that there are one or two points in connexion with the Farm "which have not yet been fully considered." On this I may comment that the Farm, which is only thirteen miles distant from Tivoli, is very familiar ground to me, and I still find in the course of frequent visits new points of interest. One of such points is the location of the front door of the house with *vestibulum* and *fauces* such as we find in Pompeian houses. We know there was great variety in the arrangement of Roman villas; but one would think there must have been a front entrance here other than the garden door, which would be the *posticum*, situated at the furthest, that is the south, end of the garden and its surrounding colonnades. Professor Lugli's Report (1927) shows beyond a doubt that this was Horace's site, but he gives no suggestion of any such front door, and in preparing the plan for my small book, "Horace at Tibur and the Sabine Farm," published by the Harrow School Bookshop at the end of that year, I was not able to suggest one.

On a recent visit, however, I found that the continuous wall, about two feet high, at the east end of the long passage which runs through the house, and topped with cement to preserve it, was partly modern, made by the excavators in 1913. Here I have no doubt was the formal front door of the house, leading to a *vestibulum* and at a little distance from the *atrium*. Professor Lugli tells us that remains of a road have been found leading from the Vico Varo road to the south end of the garden. I suggest that there must have been also a smaller road leading out of this principal road along the east side of the garden, between it and the chestnut grove (beloved of nightingales) and passing the front door. The accompanying plan from my book on "Horace at Tibur and the Sabine Farm" will show what I mean.

I believe with the late Mr. George Dennis that the Fons Bandusiae is over an hour away in the mountains. But a young Cambridge friend rather acutely suggested an argument in favour of the nearer site. "How did Horace get his victim kid up to that distant and difficult place?"

Yours very truly,

G. H. HALLAM

S. Antonio, Tivoli, Italy.

VITAMINS AND "SCURVY."

To the Editor of DISCOVERY.

SIR,

Some remarks in the article on "Vitamins and Sunlight" (January, 1929)—and also the following sentence from the "Bicentenary of Captain Cook" (September, 1928): "Perhaps the cleanliness in the fo'c'sle, an innovation, did *not* combat scurvy"—induce me to offer some experiences of my own. As a layman I do not wish to deny the conclusions come to by scientific workers that sunlight is of no value against scurvy, but it certainly appears to me that there is some factor as yet unaccounted for.

Twenty odd years ago, in the back country of Western Australia living was often hard, and it was an experience of mine to live nearly three years on food which consisted in the main of salt beef, white flour, tea, sugar and fat. In addition to this, every three months I might have one helping, possibly two, of vegetables, with an average of about 15 lb. of jam per annum and 10 lb. dried fruit, raisins, currants, etc. For the final year for practical purposes one could cut out all the additions—except fresh meat once every three months for a couple of days—yet on this diet it took the whole period before I showed any sign of scurvy, and then only the very slightest touch. This experience convinced me that scurvy was caused or helped by some other factor than diet, for it must be understood that "salt meat," as I speak of it, is not such as a resident of a town in England would eat, but meat into which as much salt is rubbed in as possible and then dried.

I awaited an opportunity to go into the matter with sailors—that did not come until 1918, when I found myself in a prison camp in Germany with some fifty mercantile marine officers. I, of course, had to discuss the matter with the oldest among them, who had been on sailing vessels, and was most careful not to put any leading question which would have betrayed the drift of my own thoughts. But everyone I spoke to said the same thing in different words, best expressed by one as follows: "It was not so much food as conditions that brought scurvy; when one was round the Horn and the air in the fo'c'sle was so bad that the lamp had a job to burn, scurvy would be rife, whilst in warm weather, near the tropics, when men spend their off watches on deck and there was plenty of fresh air in the fo'c'sle, scurvy was not nearly so rife."

Here, Sir, I must leave the matter for more able brains to answer, but I should like to add that, in common with many men prospecting, etc., in years gone by, using of necessity tinned meat, I have learnt to believe that beyond the want of "good" vitamins in tinned food there is present an as yet unknown and unidentified something—a bad or poison vitamin, if such an expression is permissible. Otherwise, how could a man showing and feeling the bad symptoms caused by living on tinned meat recover by changing his diet on to the aforementioned very salt meat? I have both seen and experienced this myself.

Yours truly,

CLAUDE L. PIESSE.

Kelmscott, Western Australia.

A New Pocket Camera.

WHEN applied to cameras, as often in the case of books also, the word *pocket* is apt to be too liberally applied. Many such instruments can certainly be carried in a great coat or a large side pocket, but the camera which will actually fit in without bulkiness is not easy to find. A new model issued at £17 5s. by Messrs. Ernest Leitz, of 20 Mortimer Street, W.1, meets the strictest requirements in this respect, its size being $5\frac{3}{16}$ by $2\frac{1}{2}$ by $1\frac{3}{16}$ inches. Not only is it therefore of unusually thin build, but being made to employ standard cinema film—though used to take single still pictures—thirty-six exposures are obtained from one loading. The negatives are about one square inch in size, and may be enlarged to quarter plate or greater magnification in a simple printing apparatus made for this purpose. Leitz lens are already well-known, and the "Leica" camera, as the new model is called, is a valuable addition to the range of cameras suitable for the amateur who wants something conveniently portable.

The Woodchat Shrike.

By E. W. Hendy.

Author of "The Lure of Bird-watching."

The Woodchat Shrike is so rare a migrant, and especially in the west of England, that some account of this bird which the author observed will interest many field-naturalists.

It was in Somerset at the end of May that I first saw the woodchat shrike, a male of the species. It was perched on one of the topmost sprays of a sloe bush about one hundred and fifty yards distant, and I took it for a stonechat or whinchat, but field-glasses at once disclosed its shrikish contours and the chestnut head settled its identity. This chestnut, seen in bright sunlight, is of a very brilliant, lustrous shade, and extends well down on the nape and upper part of the mantle. The rest of the mantle is brownish-black. The white breast looks cream-coloured in some lights, and in others yellowish. This feature is very conspicuous when the bird perches, according to its more usual custom, upon an isolated branch, but when, as occasionally happens, it settles low down in a bush, the white resembles a patch of light, showing through the foliage, and as the rest of the plumage is less brilliant its colouring becomes protective. Viewed from behind, the white bars on the secondaries form a horse-shoe mark over the dark mantle and shoulders, and the white bases of the primaries make a striking patch upon the angle of the wing. When shut, the tail looks black, but in flight the white outer feathers and rump show up vividly. The impression made on the eye is of V-shaped white patches on either side of a darker eyot. The black or leaden coloured beak is stout and powerful, and reminded me of a hawfinch's beak, for the hook on the upper mandible is not easily seen in the field. The large, dark eye, rimmed with yellow, contrasts strongly with the fine white lines between it and the bill; set, like the red-backed shrike's, in a streak of black which extends across the forehead, it suggests malevolence.

THE WOODCHAT.
Reproduced from T. A. Coward's "Birds of the British Isles," by permission of Messrs. Frederick Warne & Co.

While flying the woodchat is very chequered in appearance, from the white patches and streaks on wings, tail and rump; this is especially so when the long, white-tipped tail is spread fanwise, as the bird hovers in the air for insects. While thus engaged the head is depressed, and follows the direction of the flight of the insect pursued. More often the bird sits hunched up upon a spray of gorse or bramble, or on a telegraph wire, raising and lowering its tail to preserve its balance. Twisting its head and neck from side to side, and even backwards, it scans the field below, until it pounces headlong upon its prey. This is often held with one foot and eaten on the perch, but sometimes it is consumed on the ground.

The woodchat was not popular with other birds. Stonechats, brown linnets, whitethroats and dunnocks followed it about when it trespassed on their territory, and one cock stonechat attacked it. I did not hear any song or call note, nor could I discover any larder. I found one of its castings, which consisted entirely of beetles' wings. This bird was fairly tame and on several occasions allowed me to approach within twenty yards of it; in fact, it circled round me and my companion the whole of one afternoon. I watched it again the next day for a short time. When it settled on grass to devour a beetle, it was a very conspicuous object against the green background. The morning after, it had passed on, and I never saw it again. Though I have watched in succeeding years for its return, the woodchat has never paid us another visit.

Book Reviews.

The History of the Devil. The Horned God of the West. By R. LOWE THOMSON. (Kegan Paul. 7s. 6d.).

The Magic Islands. By W. B. SEABROOK. With drawings by ALEXANDER KING. (G. Harrap & Co. 12s. 6d.).

By calling his book " The History of the Devil," Mr. Thomson raises hopes which are not fulfilled, though, no doubt, he would put forward his sub-title as a justification. He does not attempt to elucidate the history of the Satanic idea through the ages. He is concerned only to show that certain religious and ritualistic conceptions which archaeological interpretation attributes to palaeolithic man survived in Western Europe through prehistoric to mediaeval times, when they were responsible for practices which gave rise to the witchcraft prosecutions, and of which the cult of the devil was the central feature.

Naturam expellas furca—the poor old " Devil," having been scotched by theology, is now in process of rehabilitation by science. Mr. Thomson provides him with a long and distinguished pedigree in which he shows that after outliving his " survival value," he has been undeservedly vilified by both Church and State.

Briefly, Mr. Thomson's argument is that the mediaeval idea of the devil—a being with horns and cloven hoof—is ultimately derived from the representations in the palaeolithic caves of human beings wearing animal masks. The horned and tailed figure of a man disguised as an animal in the cavern of Trois Frères at Ariège in France presents a similarity too striking possibly to be overlooked. These representations have been interpreted as those of worshippers or magicians who have identified themselves for magical purposes with the animals they wish to influence, and to whom they must show reverence—with ulterior motives, namely, that of increasing the food supply. The Trois Frères figure may even be that of the God himself. He is, at any rate, represented in a position which dominates a group of animals in which no less than thirteen different kinds are represented. A further link between the conceptions of palaeolithic man and mediaeval ideas has been suggested in an interpretation of the painting of the Spanish Cave of Cogul, which shows a group of women in a circle around the figure of a man. This is thought to be a ceremony analogous to a witch dance.

Mr. Thomson examines mediaeval beliefs in the devil and in witches in the light of these interpretations with a view to demonstrating their descent from palaeolithic times. He makes out a strong but not an entirely convincing case. It is certainly true that a memory of a horned deity persisted into early mediaeval times. The rites of the horned worshippers were carried out in Charlemagne's day; they survive now in the Abbot's Bromley Horn Dance. Both Miss Murray in her " Witch Cult in Western Europe " and Mr. Thomson regard the devil and witchcraft as a survival of this early form of pagan religion. Yet the conception of the worship of the principle of evil which is involved in the idea of the devil and the fully developed Witches' Sabbat is a product of the East. Therefore, whether the classic goat-footed Pan with fauns and satyrs or the Celtic horned Cernunnus is to be charged with the paternity of the mediaeval devil seems an open question. Pan is still under suspicion, notwithstanding Mr. Thomson's ably argued treatise.

In " The Magic Island " we deal with another aspect of the same belief, though in a very different setting. The Magic Island is Haiti, the Negro republic, where the author has been at some pains to study social and cultural conditions at first hand. His favourable impression of the highly educated Haitian need not detain us, though his observations are both entertaining and instructive. It is his relations with the uneducated negro and negroid peasantry which are of particular interest. It is, of course, well known that it was in Haiti that the negro cult of magic, which existed under various names in different parts of America—in Haiti it is known as Voodoo—was found in its most highly-developed form. The full ritual of Voodoo, it was known, entailed the sacrifice of a " hornless goat," in other words, a human victim, and there is abundant evidence that it was carried out to the last detail in recent times. Mr. Seabrooke describes a Voodoo sacrifice at which he was present. Both the girl who should have been the victim and her surrogate, the goat, were together laid before the god. The account contains some remarkable features which may be commended to the attention of students of primitive religion. Even if the name " Voodoo " be derived from the French popular term for witchcraft (" Vaudoisie ") the ceremony bears no more than a generic resemblance to the European ritual and does not appear to be derivative.

The illustrations, that is, the drawings, seem to require an explanatory note. Are they merely ultra-modern, or are they interpretative or do they attempt to reproduce the style and spirit of African carvings? Considered merely as illustrations they repel.

E. N. FALLAIZE.

Locusts and Grasshoppers: A Handbook for their Study and Control. By B. P. UVATOV. (The Imperial Bureau of Entomology, London. 21s.).

This is an English edition, with alterations and considerable additions, of a Russian volume published in 1927. The object of the book is to give a general survey of the known facts concerning locusts and grasshoppers, their bionomics and the theory and practice of their control, the author having himself made a number of contributions to our knowledge of this interesting family.

The book is divided into General and Special parts, the latter including monographs upon several well-known species; chapters upon the grasshopper and locust problems in certain parts of the world; one devoted to miscellaneous grasshoppers and species that swarm occasionally; and a final chapter on General Conclusions.

In these nineteen chapters are included all the information on this important group of insects, collected by one who is himself one of the best known authorities upon the group, and the conclusion he has come to, after amassing all the material, is that there are immense gaps in our knowledge of these insects which have thrust themselves upon the attention of mankind from the earliest times of which we have records. It is interesting to notice that, in 1921, the author published a paper on " A Revision of the genus Locusta of Linnaeus," in which he showed that the name Locustidae, previously given to the Long-horned Grasshoppers, belonged to what had so far been called the Acridiidae or Short-horned Grasshoppers. It will therefore come as a surprise to many entomologists to find, not only that the author has adopted the name Acrididae (not Acridiidae) for this family, but also that there is not a word of explanation as to the reason for his recantation. Are we to follow the

admitted authority on this group, or are we justified in accepting what appeared to be excellent reasons for adopting the name Locustidae in the absence of any explanation to the contrary?

There is no doubt that this book will prove exceedingly useful, not only because it gives very complete information as to control measures, but also because it clears up many points on the systematic side showing, for instance, that species have been wrongly identified in different countries so that there has been considerable confusion as to the life-histories.

Here is a comparatively small group of insects which, because of the way they injuriously affect mankind, have caused Governments to hold conferences with a view to exchanging information and to employing joint action to control them, and yet we now find that there is still much to be learnt concerning them. What must our ignorance be concerning the larger groups of insects and what a magnificent field of exploration for the rising generations of entomologists!

Frank Balfour Browne.

Practice, Fatigue, and Oscillation. The "British Journal of Psychology," Monograph Supplements No. XII. By J. C. Flügel, B.A. (Cambridge University Press. *8s. 6d.*).

This monograph describes an experiment with forty-six subjects working at Kraepelin's adding sheets for twenty minutes on each of forty-six successive working days. From the results interesting correlations between initial ability, improvability, daily variability in output, fatigue, oscillation—*i.e.* difference in output from minute to minute and from one five-second period to another—intelligence as measured by tests and scholastic ability are deduced. All this is done admirably—the expression of Mr. Flügel's points is never vague, and their arrangement always orderly.

The experiment started after five practice meetings. The adding proceeded continuously. Every five seconds an electric bell gave a short peal. At the end of each minute the experimenter called sharply "Now!" The subject made an appropriate mark for each signal. These signals enabled the experimenter to know the precise period to which any given portion of the work should be attributed. The incentives to work were strong. The school-girl subjects were very keen, and there was a system of monetary rewards so arranged that each girl on each day stood an interesting chance of obtaining one of these rewards by her efforts to beat, if not everyone's, at least her own, past efforts.

By "ability" Mr. Flügel means not "general ability" as tested by intelligence tests, but "ability to add Kraeplin's figures." In this ability there were considerable individual differences both at the start and the finish of the experiment. The more able subjects showed less day-to-day variability, *relative to their ability and improvability*, than the less able subjects and were less susceptible to the fatigue decline. The more able subjects, though oscillating more absolutely than the less able, oscillated less relatively to their total score for the experiment. Since "a subjective fluctuation" (by which Mr. Flügel presumably means "a lapse of attention"), would have more effect on the score of an able subject than on that of a less able, greater absolute oscillation and *equal relative* oscillation might be expected. Since the able student has, in point of fact, *less* relative oscillation we may conclude, (1) that with most subjects improvement is connected with a less liability to lapses of attention, and (2) that fatigue involves as one of its factors an increased liability to lapses of attention. The use of a special signal given once a minute produced a marked rhythm in the shape of less output near the signal. This rhythm made it impossible to discover any natural periodicities in the work curve. Ability in the experiment and ability in intelligence tests correlate to the extent of 0.29.

Mr. Flügel has given us an example of careful work, cautious thinking and clear expression.

J. Wisdom.

Every Inventor his own Patent Agent. By W. H. Baraclough. (Effingham Wilson. *20s.*).

This book is intended to provide the inventor and manufacturer with information in non-technical and non-legal language, which will enable them to dispense with professional assistance in obtaining a patent and in protecting their interests in the patent in all matters relating to it. The procedure adopted in the examination of specifications and grant of patents by the Patent Office is discussed, and much good advice is given to the inventor to assist him in obtaining the fullest protection for his invention. If he wants to protect it in foreign countries, he will find a section giving some information about fees and requirements in other countries. Some typical British specifications are printed as a guide, and full information is given as to forms and fees. The commercial aspect is also dealt with, and the inventor is given good advice regarding infringements, assignments, mortgages, licences, contracts, and oppositions. The law relating to designs, and their relation to patents, is explained.

The book is not free from ambiguities and mis-statements, such as that on page 51, where it is stated that "protection commences from the day when the application has been formally accepted"—a clear divergence from Section 13 of the Patents Acts. It may be doubted whether the average inventor would ever plunge so deeply into the complexities of the law as to make full use of this book, or indeed, whether he would be wise to attempt to do so without seeking professional assistance. But there is undoubtably scope for a book which makes possible a fuller understanding and more intelligent co-operation between the inventor or manufacturer and his patent agent. The large mass of information in this book is exceptionally fully indexed.

The Bases of Modern Science. By J. W. N. Sullivan. (Ernest Benn. *12s. 6d.*).

The Life of Space. By Maurice Maeterlinck. Translated by Bernard Miall. (George Allen & Unwin. *6s.*).

Mr. Sullivan tells us that he has found by experience "that men of but literary education, highly intelligent, logical, imaginative, have all their mental powers instantly paralysed by the sight of a mathematical symbol." For this reason, therefore, and because he has written for the intelligent general reader, he has written an outline of scientific progress from the Copernician revolution to the present day without the aid of illustration which mathematical formulae afford, although that progress is due to a measure of success in describing Nature mathematically. The scientific reader may have just cause for criticism in finding that many details and difficulties are ignored for the sake of simplicity; the treatment of the subject is one not primarily intended for him. It is pointed out that "what we call science is not man's first attempt to introduce order

into Nature; it is merely his first attempt to introduce a particular kind of order. . . . The Copernician theory, which may be taken as the first great departure in the application of the mathematical criterion, had nothing to recommend it but its mathematical simplicity. It appeared contrary to the immediate evidence of the senses, and those who insisted that knowledge must be empirical were bound to reject it."

From the time of Copernicus onwards the author traces the course of each new development in scientific thought and its effect on contemporary "fundamental" conceptions. As we reach more modern theories the instructive value of this book increases, for from discussing the Electric Theory of Matter the author passes on to a historical survey of the developments leading up to Einstein's Theory of Relativity and the Quantum Theory, and the new problems to which the modern physics leads us. In conclusion he states that "science tells us much less about the universe than we used to suppose. It is limited . . . because science, by its very nature, can tell us nothing about phenomena but their structure. . . . Our aesthetic and religious experiences need not lose the significance they appear to have merely because they are not taken into account in the scientific scheme. It is even possible that they will not always remain excluded from the scientific scheme."

This volume is not only an interesting but a valuable contribution to the general literature on the implications of scientific thought.

The "Life of Space" contains five essays on the fourth dimension, the cultivation of dreams, the isolation of man, the nature of space and time and the nature of God. The first is built upon a summary of all that has been written on theoretical speculation of worlds of few or many dimensions. The translation is in places involved; but the general reader, for whom this book is intended, must remember that Maeterlinck is a poetical genius whose assumption that the horse is only conscious of two dimensions can hardly be said to be based on scientific observation.

The South Polar Trail. By ERNEST MILLS JOYCE. With an Introduction by HUGH ROBERT MILL. (Duckworth. 10s 6d.).

The Imperial Trans-Antarctic Expedition in which Sir Ernest Shackleton planned to cross that continent during 1915 and 1916 was unsuccessful in achieving its initial object. The misfortunes, however, with which both the Weddell Sea and Ross Sea parties successfully contended provide some of the most heroic episodes in the history of exploration.

The story of the *Endurance* party, under the leadership of Sir Ernest Shackleton himself, has previously been told, but little has been heard of the Ross Sea party, who laid the line of store tents from Cape Evans southwards to the Beardmore Glacier for the use of the members of the former after they had crossed the continent. The Ross Sea party in the *Aurora*, under the command of Captain Mackintosh, arrived at their base in January, 1915. In the following May, with all extra clothing and sledging equipment and the majority of the general stores on board, the ship drifted away in the pack ice, not to return until Sir Ernest Shackleton relieved the survivors in January, 1917. The hardships of the journeys made in laying the depots, increased by scanty and improvised outfits, are told in this book in candid detail by Joyce, who was in charge of the stores and sledging equipment. It is not difficult to read between the lines of this diary of endurance and realize the nature of the test of Arctic exploration—the self-imposed fight of heroic adventurers against adverse circumstances, disease and death. This is indeed a thrilling narrative written from the log of the sledging parties.

The Origins and the Growth of Chemical Science. By J. E. MARSH, F.R.S. (Murray. 5s.).

Chemistry in Daily Life. By S. GLASSTONE. (Methuen. 6s.).

The attempt, in the first of these books, to show "that the progress (of the Science of Chemistry) has been uniform and gradual, each advance being based on what has gone before, and leading to further advances in a perfectly natural and logical sequence," has certainly been successful as far as space has allowed. The fire theories and the story of their final overthrow by Boyle and Lavoisier, amongst others, are first discussed. The succeeding accounts of the Salt Theory and the ideas which led up to Dalton's Atomic Theory are links in the chain of consecutive thought based on experiment which leads up to the modern theories of stereo-isomerism and crystal structure.

The second book is based on series of University Extension Lectures and broadcast talks. The interest of listeners stimulated their expansion into the present volume. Beginning with a short account of the origin and development of the science, the subjects discussed include the chemistry of digestion, vitamins, dyes, coal, perfumes, oil and clothing. They are all dealt with in an elementary and popular style.

Matter, Electricity, Energy. By WALTER GERLACH, Ph.D., Professor, University of Tübingen. Translated by FRANCIS J. FUCHS, Ph.D., St. John's College, Brooklyn, N.Y. (Chapman & Hall. 30s.)

This is a translation of the second edition of Professor Walter Gerlach's excellent book on modern atomic investigation. The work is not primarily intended for the advanced physics student, although it would be difficult to imagine a more valuable addition to his reference library. It has its greatest value, however, in its appeal to specialists in other branches of science. Modern atomic physics cannot be confined within a specialized syllabus and the engineer, chemist, or technician is almost as much concerned with the significance of atomic investigation as the pure physicist who is responsible for its progress.

The book may be read, with great profit, as a whole, but the chapters will be found to be concise discussions of the various subjects indicated by their titles. This arrangement adds considerably to the value of the book as a work of reference. It is well printed and the diagrams are clear and informative.

The treatment of the subject is in general non-mathematical, but rather it aims at general explanation of "atomistic" phenomena in current scientific language. The translator is to be congratulated on having realized the author's intention in this respect. One or two of the chapters deserve special notice. The difficult question of the continuous X-ray spectrum is dealt with in a full and remarkably clear manner. Considerable attention is devoted to a discussion of the increasingly important subject of infra-red spectra which incidentally also formed the theme of a most interesting discourse delivered recently by Sir Robert Robertson at the Royal Institution.

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